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THE ASIATIC TWO-HORNED RHINOCEROS

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In this paper I wish to describe the habits of the Asiatic two-horned rhinoceros (*Didermocerus sumatranus*) as I have observed them in British Malaya. Elsewhere the animal occurs in Borneo, Sumatra, Burma, Siam and Indo-China, but it is now being exterminated throughout most of its range. Probably its habits are everywhere much the same as I have observed them.

PHYSICAL ATTRIBUTES

Didermocerus sumatranus is not a very large animal. I think the maximum height for a male would be about 4½ feet at the shoulder, this being the measurement of an old male I obtained in Ulu Benus, Pahang. This beast, which was stocky and bulky, measured 96 inches in girth directly behind the shoulder and 102 inches in length from the end of his nose to the rump, as near as I could measure it. These measurements were taken on a steep hillside so cannot be considered as very accurate. But I have measured other rhinoceroses and the mature animal, whether male or female, has invariably been more than four feet high at the shoulder. One very old female whose molars were worn down almost to the gum measured 4 feet, 3 inches at the shoulder. The measurements of the horns of this animal are given under no. 4 in the table below.

The color of *D. sumatranus*, which has been mentioned as differing from the variety called *lasiotis* and supposed by Lydekker to be blacker than the northern variety does not, in my opinion, entitle the subspecies *niger* to recognition. The color of the hide of the Malayan variety is a dark gray, and the underside of the skin, on the belly, under the forelegs, and in the groin, distinctly shades towards pink. The blackest part of the rhinoceros is the horn; even the head is not as dark as the horn. The tail is bare and short, and tufted with sparse hairs. The ears, which have been taken as

differing from those of the more northern variety, have a very short fringe and a few hairs on the inside, but no mature rhinoceros living in the dense jungles of Malaya, behaving in the way it does, could possibly save long hairs on the edges of its ears. The young rhinoceros has hair but this disappears as the animal ages and only very short hairs, almost bristles, are found on most of the exposed parts of the mature animal. A young rhino following its mother once passed very close to some of my men and it was noticed as being hairy.

There are two very long horns in the British Museum that are labelled as having been produced by *sumatranus*. These horns, according to Rowland Ward's Records of Big Game, measure $32\frac{1}{8}$ and $27\frac{1}{8}$ inches in length, but the

FIG. 1. Mounted head of male Sumatran rhinoceros.

next in size recorded, from the Malay Peninsula, reaches only a length of 15 inches. The Datok Raja Kiah of Jelebu in Malaya told me that he had once obtained a *sumatranus* whose front horn measured about 20 inches in length, but I am afraid I cannot attach much importance to the measurement although the horn was probably abnormally long. I think that any anterior horn of a *sumatranus* measuring more than 10 inches, and any posterior horn measuring more than 5 inches should be considered as above the average. The females have smaller and less rugged horns than the males, and seldom show anything but a small development of the posterior horn. In an old male the whole of the top of the nose both around and in front of the horns becomes a mass of horn and at times may develop small lumps that might

almost be called subsidiary horns. I have seen two heads with what were almost third horns, and the illustration of the mounted head of a male *sumatranus* clearly shows a small horny protuberance over the left eye (fig. 1). The horn is merely agglutinated hair and as the rhino is very fond of rubbing his horn against trees one can imagine that rough surfaces may easily become enlarged into embryo horns. The horn appears never to be used as a weapon, the large incisors in the lower jaw being depended on for both defense and offense.

The following are the measurements of the horns on four mounted heads of *Didermocerus sumatranus* obtained in Malaya.

	LENGTH ON OUTSIDE CURVE OF HORN		CIRCUMFERENCE OF HORN	
	Anterior	Posterior	Anterior	Posterior
No. 1	10¼″	6″	18″	16½″
No. 2	9″	Broken	22″	14″
No. 3	7½″	4½″	16½″	12½″
No. 4	8½″	1½″	15″	10″

Numbers 1, 2, and 3 are those of males, number 4 that of a very old female with teeth worn down to the gums. These measurements can be taken, I think, as typical of the class of horn that was obtainable in Malaya.

The *sumatranus*, for his height, has a fairly large foot. The greatest measurement of the track of a fore foot that I have recorded was 9½ inches across the widest part which would be to the outer edges of the two lateral toe nails. Measurement of the centre toe nail, in this case, was 3½ inches wide. Another track that I measured of what was a slightly smaller beast was 8½ inches across with a centre toe nail measuring 2¾ inches. These were all measurements of fore feet. The hind feet are narrower and the toe nails generally slightly longer. The older the rhinoceros the more he digs his toes in when going up hill, which I believe he must do every day of his life. Anyway, he always did whenever I followed him! The result is that his toe nails get shorter as he gets older. The impression of a short but wide toe nail indicates old age. This is in contrast to the wild elephant, which, as he grows older, tends to carry his weight on his heels, his toe nails then inclining to grow longer.

The most extraordinary portion of the external anatomy of the *sumatranus* is his sheath and penis. The sheath points backward and the result is that when the male urinates he does so behind. This is the only definite clue that one has to the sex of the animal one is following. The illustration (fig. 3) shows the sheath and although not very clear it can be seen that it hangs down like a scrotum. If the male urinates when he is walking or even running he appears to throw his penis backwards and his urine shoots up into the air between his legs. In an article by W. S. Thom in the Journal

of the Bombay Natural History Society (volume 38, no. 1, August 1935) on "Rhinoceros shooting in Burma," he states that this habit of urinating on the bushes is found in the female, but I do not think that this is so. Several

FIG. 2

FIG. 3

FIG. 2. Sumatran rhinoceros at bay.
FIG. 3. Sumatran rhinoceros in action.

peculiarities mentioned by Mr. Thom in his article do not correspond with my experiences, but I do not wish to criticise further the writings of a very experienced shikari, so I will merely record the deductions I have made from my own observations.

HABITS AND TERRAIN

In the Malay Peninsula the two-horned rhinoceros formerly was to be found in many parts of the mountainous country and sometimes in the coast belts. It is now almost entirely a mountain animal, having been exterminated in the lower lands. It is, however, occasionally found some distance from the mountains in foot hills or dense low-lying jungle. It lives in the thickest and roughest jungle it can find, and this alone has saved it from extermination. The animal is solitary, it being most unusual to find two of them together. The Datok Rajah Kiah of Jelebu, an old and experienced rhinoceros hunter, who belonged to a type now passed from Malaya, informed me many years ago that he thought when two rhinoceroses were seen together that they were probably mother and calf except on the rare occasions when two came together as mates. I have on four occasions followed two rhinoceroses. In one case they were mating, but on the other occasions when I came across two they may have been mother and calf; apparently the calf runs with its mother until nearly full grown.

The 'To Raja Kiah caught a baby male rhinoceros which he carefully tended and kept for seven years. I did not see it when it was very young but the 'To Raja told me that it was still hairy when he got it. He shot the mother and found the baby near by. At the end of seven years the rhino had grown to a little over three feet in height. It was just showing its anterior horn, but there was no sign of the posterior horn. It foraged in the jungle during the day as it got older, had its own wallows, and returned to the 'To Raja's house in the evening for a feed of rice. When the rice was ready one of the household would call with a loud and shrill, hoh! hoh! hoh! and the rhino would answer from the jungle and come back at full speed for its evening meal. It slept under the house.

As I have written above, rhinoceroses have a poor development of the herd instinct and are extremely unsociable. I have followed them on foot through dense jungles for days but have seldom come across more than one animal. Although at times I have followed fresh tracks that crossed fresh tracks of another animal I have seldom known them to unite. On one occasion when I was following the tracks of two big beasts another one crossed their trail and followed them. So then there were three. But the urge was obvious because presently we came to a place where two of them had had a tustle and the third had lain down near by, no doubt wondering which was to be her future lord and master. I thought I was going to see a rhino fight and followed up the tracks but I saw no signs of anything of the sort. There were some more traces of struggles and then one animal went away and left the two to continue their honeymoon.

Of all the difficult and exasperating animals to follow through dense jungle the rhinoceros easily takes first place. They invariably go through the thickest undergrowth they can find and will deliberately leave a game path

to go through, or under, or over, some fallen tree. When once they are wise to the fact that they are being followed they excel themselves in ingenuity. Nothing is too difficult for them. I remember once tracking a rhinoceros up a steep rocky hillside in very rough country. We came up to him almost on the top of the hill. He heard us, I suppose, and turned round facing the direction we were coming from, but carefully put a large fallen tree and a dense thicket of rattan between himself and the direction of our approach. We could see nothing but were suddenly brought up all standing by a tremendous snort just in front of us. Then came a short rush away from us, cessation of all sound, and another magnificent snort, more like an engine blowing off steam than anything else. This was followed by a shrill squeal, denoting that he had smelt us, and away he went crashing through everything. We saw nothing at all. He rushed down a dry gully and when we followed painfully in his rear—by that time he was far away—we found that when tearing down this dry water course which was full of granite boulders he had come to a place where the formation broke away and he had a sheer drop of twenty feet. That did not bother him, he just took it in his stride, nor did the flat slab of granite at the bottom on which he landed check him in any way; he had continued his rush as if nothing out of the ordinary had happened. We followed him up for some miles before he stopped and then he had amused himself by rubbing his horn against a tree, taking off rather more bark than usual, and kicking up a greater amount of earth at the foot of the tree than is customary. That was the only indication that he remembered that granite bed-rock. And so it is always with them. They seem impervious to any physical feeling of discomfort. Their walking powers in bad country are phenomenal. I have often followed rhinos that have laboriously climbed—I should say *we* have laboriously climbed—a high mountain merely to go down the other side. A rhino that has been scared may do this two or three times during a day without stopping except to take a quick wallow if he comes across a mud hole, and at the end of the day the unfortunate people following him will be perhaps so far behind that it will take two or three days to catch up with him.

The hunting of rhinoceroses by tracking is a very difficult business and if that were the only way to get them the species would have been in no danger of extinction. But unfortunately the animals continually follow the same game trails, especially near their wallows or near salt licks; and it is due to this habit that they have been so persecuted. Even to this day one finds their game paths passing along side of some long disused and partially filled-up pit, showing that they have some extraordinary obsession for following almost the exact line that generations of their kind have adopted.

When travelling through the jungle on their ordinary rounds rhinoceroses move slowly and steadily, covering a great deal of ground during the twenty-four hours. But occasionally if one finds some particular patch of jungle

that he likes he may hang about in the vicinity for some days. They particularly favor the heads of narrow valleys, where they generally have well-used wallows, plenty of thick undergrowth and precipitous sides to the valley so that they can have plenty of exercise. An ideal place for a rhinoceros to frequent is jungle so dense that a human can see nothing within five yards except a wall of forest, and so steep that he cannot walk without holding on to something, which something will almost certainly be thorny. Another type of jungle favored by them is one interspersed with the large bamboo known to Malays as "buloh semeliang" (*Dendrocalamus giganteus*). This bamboo grows quickly and to a great height, thus not having much rigidity. Much of it falls towards the ground while still alive and on steep hill sides the bamboos thus fallen will present an almost impenetrable tangle. But the rhinoceros does not bother about this; he goes under the bamboo letting the tangled mass pass over his back. This bamboo fractures easily, leaving an edge as sharp as a razor, which will cut one to the bone. To follow a rhinoceros along a steep hill side where he has passed under buloh semeliang is a very ticklish business and if your party gets through without casualities you will have done well. I have seen an elephant's trunk cut very severely by one of these bamboos when he was rushing down a hill after getting a taint of human scent. But these things do not bother the rhinoceros; in fact nothing, except human scent, seems to worry him.

In a very remote part of the Malayan jungle there was an old rhinoceros of which I tried to make an intensive study. I followed on his fresh tracks for a total period of forty days, spread over five expeditions. I heard him three times, was very close to him several times, but saw him never. His habits were fairly regular until he became alarmed and then he was the cunningest thing in the jungle. The country he frequented was not high but extremely steep and covered with thorns of many sorts. The worst obstruction was a palm called by Malays "chuchor" (*Calamus castaneus*). It grows in dense clumps from the ground to a height of about ten feet, and is very thorny. This palm jungle was interspersed with rattans of several varieties and most of the terrain followed by the rhino when he was alarmed was along steep hill sides heavily wooded and covered with chuchor. Directly he knew he was being followed he tried every trick known to the tribe to give us the slip. He never stopped any time in his wallows—to make up for that he wallowed frequently—and he continually made huge circles coming back on his tracks about once in two days. One day he came close to one of our camps which had been used by us two days previously. When some distance away he became aware of the proximity of the old camp and stopped before he came to the banks of a river on the opposite side of which was our camping place. He then turned back and went in another direction. His habits seemed to indicate that he was very old. He had an exceptionally wide track, 9½ inches across. He also had little control

over his urine because when alarmed he had an almost continual dribble for a mile or two. But I have noticed on other occasions that rhinos when alarmed and panicky would do the same thing, but they did not go on for half an hour as this old fellow did. He never ran far but he never seemed to stop. A fast walk which he could keep up for miles defeated us. Whenever we did get up to him he would slip away without our seeing him, and we knew that it would be two or three days before we would have a chance of getting close to him again. We used to track him all day, camp on his tracks at night, and off again early next morning; still he defeated us.

His food was little else then the twigs of trees. This indicated that his teeth were much worn, because generally the rhinoceroses chew up more of the trees they push down than just the slender twigs. He found and demolished large quantities of jungle fruits which were easy to swallow, stones and all, but his digestion was all right because they never seemed to upset him. A favorite trick of his was to get into a river and follow it for half a mile or more; he would then find a place well concealed on the bank and leave the river by climbing over stones or roots or something in which his trail would not be conspicuous. At another time I followed a rhinoceros that went down to a river and first walked about half a mile upstream and then about a mile downstream, and back again for about a quarter of a mile upstream to the mouth of a small stream which was full of large stones on which he walked until he was well away from the main river. There he climbed the bank and disappeared into the jungle. This maneuver delayed us the best part of a day.

All rhinos are very fond of wallowing, something that is essential for their very existence. Their hides are extremely thick but their epidermis is thin and sensitive and the flies that follow them no doubt irritate them and make the habit of wallowing a very natural one. Normally the rhinoceros wallows once or twice in the twenty-four hours, more often in hot, dry weather. It it also fond of walking and swimming in the rivers. I have never seen any evidence of their lying down in the rivers although they invariably lie down in their wallows. Their wallows are generally situated under a bank, but sometimes in a swamp. Wallows under banks are made in such positions, I believe, because the rhinoceros likes to dig into the bank with his horn. This is done, no doubt, to make the mud in the wallow the right consistency, because after heavy rain the mud in the wallow would be very thin and would probably not stick properly to his hide; so he thickens it up a little by breaking down the bank with his horn or with his forefeet. The banks become hollowed out as the illustration shows. Before the days of intensive rhinoceros destruction in Malaya it was possible to find as many as seven or eight wallows near together under a bank and all in use. At one salt lick in Ulu Pahang, a salt lick well patronized by rhinoceroses in their palmy days, I found no less than five large wallows in a series, almost touching each other. Near

FIG. 4. Disused rhinoceros pit.

FIG. 5. Wallow used by rhinoceros. The bank is dug out by the animal with his horn and his feet.

another lick there were eight. They are no longer used because the rhinos are gone.

I have known a rhinoceros that had been disturbed and then followed to wallow as many as six times during the day, remaining only a few minutes in each wallow, rolling about to get himself thoroughly covered with mud and then on again. In one place he had obviously thrown himself into the wallow, probably hot and bothered, because the mud was splashed everywhere in the vicinity. On another occasion when I was following a rhinoceros in very rough country, too rough even for him to find a wallow, the animal tried to wallow in a little stony gully with about two inches of water at the bottom. I think that the necessity to wallow must be very great, otherwise alarmed animals would not be so anxious to perform the rite. Possibly the sensitiveness of their skin demands a coating of mud, although that is scarcely consistent with their fondness for going through the thickest and thorniest jungle they can find. Flies certainly bother them, especially a large unidentified variety of *Tabanus*, with a blue abdomen. They are also attacked by a special type of tick, the only jungle tick that I have come across which will with ease drive its proboscis through thick shikar cloth. Of course compared with rhino hide this feat must be a mere nothing; but the ticks that attach themselves to the wild cattle of the Malayan jungles cannot do it. The ticks appear to fall off the rhino long before they are gorged; in fact at times I have seen rhino ticks on the trail which had evidently not had a meal at all, and yet I believe that they must have come from the rhino's body.

Most of the salt licks affected by rhinos are sulphur springs which are generally situated among rocks. These rocks are polished quite smoothly by the animals that use these licks. For many years I thought that these polishings were the result of the licking of the rocks for some inherent benefit in the rock itself, but I subsequently found out that the rocks are licked to remove from the lips or mouth of the animal a peculiar type of small leech, akin to the horse leech, that lives in the slime of the sulphur water. I first noticed this fact while watching a tapir in a sulphur lick and subsequently often saw sambhur deer do the same trick. I have a film clearly showing a sambhur stag rubbing his lips on the rocks after taking a long drink at the sulphur water. The rocks are also polished by the animals' bodies as well as by the process of removing leeches from their mouths and lips, and it is not surprising that centuries of such contacts have smoothed over all the rocks in the vicinity of a lick. Rhinoceroses also visit mud-licks that show no exudation of sulphur but probably contain some trace of sulphur or possibly of salt. There is, I think, no doubt but that wild animals visit salt licks for the purpose of cleansing their stomachs and intestines of parasites. Wild cattle droppings will be almost pure mud after a visit to a mud-lick, and I have often come across the dung of elephants slimy and covered with mucus after a visit to a salt lick.

SENSES

The senses of hearing and smelling in this rhinoceros are extraordinarily acute. The enormous nasal cavities no doubt enhance the power of scent, and the habit that the animal has of curling up its pointed upper lip when testing the wind is no doubt an effort to utilize more of the inner surface of the nostrils to try to discover the direct line of scent. A rhinoceros that has once decided that the wind is tainted wastes no time in getting away and, as I have described elsewhere, he voices his fear in no uncertain manner. I have no doubt but that the rhinoceros relies more on his nose than any other organ to give him warning of danger. His hearing is also very acute, despite the fact that he has small ears that do not look as if they would be capable of catching much sound. The Datok Raja told me that when approaching a rhinoceros on no account to break anything along the side of the trail except the smallest twig if it was necessary to mark the route, because a rhinoceros could hear so extraordinarily well that he would be put on guard and would immediately start to test the wind in every direction. This is sound advice but a little difficult to follow when on a steep hillside with a thorny rattan holding one back by the lobe of one's ear! In the dense jungles favored by rhinos there is little movement in the air, except during a storm, and I have no doubt that the rhinoceroses, with their extraordinary powers of smell, would detect human scent from almost any direction if sufficiently close to them, even on the stillest day. Their sight is poor, in fact probably of little use for detection purposes. It can be ignored when one is stalking them.

The rhinoceros has several distinct methods of expressing pleasure, annoyance or alarm and uses both his throat and his nose to give vent to his feelings. It is interesting to know that a rhinoceros when alarmed has a very distinct way of showing his fear, as contrasted with an extremely truculent demonstration when only suspicious. As I have written already, a rhinoceros who is suspicious will face the direction where he thinks there is something out of the normal, and then give vent to a terrific blast from his nostrils. He may then turn round and trot away a few yards and repeat the process. It is merely bluff. When he gets a taint of your wind his attitude immediately changes into one of abject fear. Of all animals I think the rhinoceros must hate the scent of man more than any of the others. Occasionally a rhinoceros when suspicious will turn round and run away without any vocal display, stopping at a short distance, no doubt to listen intently. It is then very difficult to approach him because he will keep absolutely still and one is liable to run almost into him. But when he gets one's wind the procedure is very different. The animal will then immediately go off at full speed in any direction—if facing you he is liable to run straight in your direction—making a noise something between the bark of a dog and the quack of a duck. It is not exactly a squeal, but a noise peculiar to a

thoroughly alarmed rhinoceros. The intensity of the quacking will generally indicate the distance he will go before he slows up. When hunting in the mountains I used to despair when I heard a rhino rush away making a series of long and plaintive quacks, for I knew that it would be days before we would be able to catch up with him. On the other hand if he is alarmed, snorts violently and then rushes off he will almost certainly pull up within a hundred yards or so, probably wondering what he is running away from!

When feeding and quite undisturbed a rhino will continually squeak and talk to himself, making some of the noises through his mouth and some through his nose. These noises can be heard for some distance. I have never heard them after a rhino has been disturbed, although followed all day. Apparently he makes these noises only when he is completely at peace with everything. There is a peculiar noise that a rhinoceros makes when in a wallow. This is a quite distinctive sound and not what one would expect from a rhinoceros. The first time I heard it I was with the old Datok Raja and we could hear a rhino splashing about in a wallow but could see nothing. Presently I heard a noise that I took to be made by a monkey, probably a gibbon, I thought. I whispered to the Datok that there was a monkey evidently close to the wallow who had spotted the rhino and that we must be careful that he did not spot us too. The old man smiled and shook his head. "That is the rhino; they make that noise when enjoying themselves in a wallow." I often heard that noise on other occasions and was hard put to it to believe that it really was the rhino and not a gibbon. The sound was low and rather plaintive, something like the low note of a white-handed gibbon but also with a faint resemblance to a bird note—a noise impossible to describe accurately. Finally a rhinoceros will squeal terribly when dying a violent death, not unlike the screaming of the sambhur deer under similar circumstances, but a much more distressing sound.

In addition to noises that present some sort of endeavor to express its feelings, there is a complete series of snorts and grunts and blowings which the rhinoceros sometimes gives vent to when wallowing, probably while trying to get the mud out of his nose and eyes. But, generally speaking, they do not make much noise when settled down in a wallow for a good rest. When lying on the ground, and probably also in a wallow, they never, I believe, lie on their sides, but fold themselves up with their legs tucked under them.

FOOD

I do not think that the *Didermocerus sumatranus* ever grazes; I have never seen any evidence of its doing anything of the sort. They eat fallen fruit but do not appear to eat grass or roots of any kind. Their principle food consists of the small branches of certain species of trees and bitter or astringent fruits. They eat bark of trees and I have once seen a rhinoceros

eating lichen or possibly the fruit of some fungus off a fallen tree; but their main food supply is from young trees that they break down. Whereas the other species of large wild life in Malaya will often find food in secondary jungle the rhino invariably feeds only in virgin forest or very old regenerated jungle. They do not appear to have any regular hours for feeding, although they frequently sleep during the heat of the day. They may, however, wallow at any time.

Rhinoceroses are particularly fond of trees of the Sapotaceae group, some of which are enumerated below. Other trees and fruits that they eat are included in the following list. The native Malay name is given in parentheses.

TREES AND FRUIT EATEN BY DIDERMOCERUS SUMATRANUS

Anacardiaceae.	*Mangifera*, spp.	(Machang berlawin) fruit eaten.
Apocynaceae.	*Dyera*, spp.	(Jelutong)
Euphorbiaceae.	*Sapium baccatum.*	(Mamaya)
Guttiferae.	*Garcinia*, spp.	(Kandis)
"	*Kayea kunstleri.*	(Gaha)
Leguminosae.	*Pithecolobium*, spp.	(Keredas)
"	*Saraca*, spp.	(Tengelan) flowers eaten.
Myristicaceae.	*Myristica*, spp.	(Penarah)
Myrtaceae.	*Eugenia*, spp.	(Kelat merah, kelat kuning, etc.)
Rubiaceae.	*Urophyllum*, spp.	(Manai badak, manai pahit, manai rumpah.)
Sapotaceae.	*Palaquium & Payena*, spp.	(Nyatoh, several var.)
"	*Payena costata.*	(Mengelut or salut) fruit eaten.
"	*Palaquium gutta.*	(Taban merah, etc.)

Of the many species of *Eugenia*, which are common in the virgin forests of Malaya, young trees are often broken down and the smaller branches and leaves are eaten. Many trees containing gum or getah are favored by rhinoceroses. Jelutong seedlings they are fond of. The gum from large jelutong trees is the principal ingredient of chewing gum. The several species of the shrub manai (*Urophyllum*) which grow in patches on hillsides are often eaten down by rhinoceroses, which are very fond of the bitter leaves.

The principal jungle fruits that they are fond of belong to the species of *Mangifera*, as well as the fruit of a tree called mengelut or salut which has a thick, sticky, creamy juice, no doubt palatable to the rhinoceros. Once when following a *Rhinoceros sondaicus* on the coast of Tenasserim, Lower Burma, I found where the animal had eaten large quantities of the bark of a tree, *Ceriops candolleana*, which grows in mangrove swamps and in tidal water. It has a bright orange inner bark and it is, I believe, used for tanning. The urine of this rhinoceros was stained bright orange by the juices in the bark.

The rhinoceros breaks down small trees by pushing against them with his forehead or chest until the tree is sufficiently bent over to enable him to

walk it down by pressing the tree under his belly. Sometimes when the tree is fairly large he may put his forefeet on the tree to bring more weight into play. He even at times holds a tree down by standing on it with his forefeet; I have often seen the marks of toe nails on the trees that have been broken down. Having lowered the tree the rhinoceros then proceeds to eat the twigs and small branches. He will move round and round the end of the tree, continually altering his position during the process.

A favorite trick of the rhinoceros when feeding is to get a sapling behind his front horn and twist it round and round until it is thoroughly decorticated and covered with mud from his head. I do not know exactly how this is done never having caught a rhino *in flagrante delicto*; but it is generally supposed that this is only done by a rhinoceros which has sufficiently long horns to enable it to twist the saplings between the two horns. I found that this was not the case. In one instance I was following a rhinoceros which had twisted a number of saplings but discovered later that it had a very poor and stumpy posterior horn. Also, I believed, for the same reason, that a female rhinoceros could not twist saplings and, when following rhino's spoor and finding twisted saplings, I concluded that I was on the track of a male that had a good horn. I disproved this by finding saplings twisted by a cow rhinoceros that was accompanied by a calf. I do not now believe that the length of the horns has anything to do with the thoroughness of the twistings and such indications are no guide either to the sex of the animal or the size of the horns.

Another favorite trick of the rhinoceros is to rub his horn against small trees and wear the bark off. This is frequently accompanied by pawing up of the earth at the foot of the tree and the sprinkling of the surrounding shrubs with urine. In this case there is generally some indication of the type of horn possessed by the rhinoceros: an old rugged horn will knock large chunks of bark off; a young horn will merely polish the bark. Much disturbance in this way to the tree and the ground around it will almost certainly indicate a male rhinoceros. I think that the pawing up of the ground may show that there is some sexual connection between the rubbing of the horn and the disturbed earth which is spread about in all directions, no doubt some of it being directed against the sheath. Female rhinos rub their horns against trees in a similar fashion but I have never noticed that this was accompanied by pawing.

GENERAL OBSERVATIONS

Rhinoceroses frequently defecate into water as well as on land. I have only once seen a place where a rhino had returned to a particular spot to defecate. Their droppings consist of round balls, in the case of a mature beast, rather larger than a cricket ball. It is impossible to tell the female from the male feces. The feces of an old animal will contain coarse and

only partly digested twigs, no doubt because of defective or much worn teeth. Often during the fruit season the feces are full of the stones of jungle fruits, unbroken but clean of all fibre. Thus does the rhinoceros spread trees, useful to himself and other animals, throughout the jungle. I have often seen young *Mangifera* seedlings growing out of an old accumulation of rhinoceros dung. A rhinoceros will never defecate in a wallow or a salt lick; at least I have never seen any signs of one's having done so. An elephant will defecate in a salt lick and foul the whole place for any other animals; and even seladang (*Bibos gaurus*) are occasionally known to offend in this way.

I am afraid I cannot write much about the young rhinoceros. I have sometimes come across their tracks but only once have been very close to a rhinoceros calf. All my men saw it but I did not. We were looking for the tracks of the old rhinoceros mentioned earlier and had been following along a game trail on the top of a narrow ridge. The ridge dipped and then climbed again. I was ahead with one man, and some distance behind were six Malay carriers and behind them six Sakai, the aboriginals of the Malay Peninsula. Presently we crossed a fresh track of what was obviously a large rhino. The lateral toe nails were far apart and I mistook the track for that of the old male. The wide spreading toe nails of this rhinoceros should have indicated to me that they were the tracks of a big female and not those of the old male I was looking for. The tracks were very new and I sent my companion back along the trail to stop the carriers, because natives cannot restrain their chattering, and I did not want them to upset my plans. Soon I heard directly below me the noise made by the rhino. I had not gone five yards before the rhino became alarmed and rushed off. The animal made a low squeaking noise and ran back towards where my men were.

Soon I heard cries of alarm from the Sakai. It all happened quickly. I had not far to go to find them. The rhinoceros, which was a female followed by a calf, had run right between them.

Apparently the rhinoceros, having gotten my scent, rushed back more or less on the level until it came out on the game path just in front of my Malays who were plodding along the narrow ridge. The rhino had nowhere else to go so just carried on. The men who had stopped, hearing something coming toward them through the jungle, scattered to each side of the ridge, no doubt looking for suitable trees to climb, but before they could do anything the rhino had passed. Some of the Sakai, who were a hundred yards in the rear, were already up trees when the rhino passed them. I questioned the Malays and Sakai very closely regarding the position of the calf and those that had observed anything told me that the calf was so close to its mother that its head was almost entirely hidden between her hind legs. I extracted this information when inquiring if they had seen any signs of a horn on the calf. One of the men said that he distinctly noticed that the calf showed a good deal of hair on it and they all said that the cow proceeded

at a slow trot and was blowing hard. They also said, which I confirmed afterwards by examining the tracks, that the calf was not very small.

The route taken by the rhino was a perfectly natural one and was more or less in the direction it was moving when I disturbed it. But had this incident occurred when I was not there it would have been described as a desperate charge and still another instance of the ferocity of the rhinoceros. The track of the rhino following along the ridge showed that she had followed more or less the centre of the path and for all she cared the men might not have been there at all. Her main object was to get away from my scent. I examined the place where the rhinoceros and her calf had been when I disturbed it. There was a wallow there which was very nearly dry, but they had been stamping about in the mud. Here the cow had twisted up a small sapling in approved style. My men had noticed merely a small anterior horn on the cow and no signs of a second horn. The tracks of the calf, which were very faint on the ridge, were easily visible in the drying mud of the wallow, and were those of a young but not very young rhino. It is very difficult to spot the tracks of a calf when with its mother because generally it keeps either just in front and so has its tracks covered by those of the larger animal or following close behind steps in the depressions made by the other one's feet.

The rhinoceros has three toes on each foot. The only similar animal in the Malayan jungle that has three toes on its hind foot is the tapir. But the tapir has four toes on his fore foot, so its tracks should not be confused with those of a rhinoceros although when tracking is difficult and the fourth toe of a tapir is obliterated by the track of the hind feet, mistakes can be made except by experienced trackers. The tracks made by a rhinoceros are not easy to follow because its large spongy feet press down leaves which spring back to their original level and only faint indications may be left by the toe nails. An old track of a day or two may easily be confused with a new track, especially during dry weather. Heavy rain will almost completely obliterate the tracks.

The rhinoceros's habit of wallowing is a great help to the tracker. His hide is always dirty. As I have written above, the tracks of the tapir resemble those of a rhino and an oldish track of a large tapir partially washed out by rain might easily be mistaken for that of a rhinoceros. The tapir never wallows, so a careful examination of the saplings or trees that the animal has rubbed against will soon show traces of mud or a mud smear if the animal is a rhinoceros.

POACHING

If salt licks have been a benefit to the rhinoceroses they have also spelt their doom, because the habit of making periodical visits to salt licks enables poachers to set traps along the many game trails leading to the licks. In

Malaya there is now little of this trapping done for the simple reason that the rhinoceroses are so nearly exterminated. But a few decades ago pitting for rhinos was a regular business and hundreds of the animals must have been destroyed. I have travelled a great deal through what was once rhinoceros country and have found dozens of old disused pits, most of them in the vicinity of salt licks. At one lick I found no less than 18 of these pits and I certainly did not find them all. They were twenty or thirty years old. So many pits indicate a former large population. There are none of the animals there now, although this is in an entirely unopened part of the country. At another well known salt lick I found eleven old pits but on one side of the lick I did not make a careful investigation. That lick is still occasionally visited by rhinoceroses, but every year their visits become fewer. In that lick I found, a few years ago, a shooting platform that had been recently constructed, no doubt with the hope of getting a shot at a rhinoceros. At another lick, in quite a different part of the country, about twenty years ago, I found that fences had been made covering each game trail leading to the lick and a spring bamboo spear placed so as to command a small opening left in each piece of fence. This was the work of the Sakai, an aboriginal tribe that does much damage to wild life in some places.

These pits, of which I give an illustration, were made with much care, every trace of the activity of man being removed. There was no difficulty in finding where to make a pit because there were numerous game trails leading to these salt licks and in the old days these trails were regularly used. A pit would be dug about 7 feet deep, 9 to 10 feet long, and 3 to 4 feet wide. The pit was constructed so that when a rhinoceros fell into it he would be wedged between the slightly sloping sides of the pit and thus be kept from reaching the bottom with his feet. Provided the animal was a big one it would be tightly held by its own weight and would be entirely helpless. The chances of its getting out were very small, unless it fell so that it could get its head into the sides of the pit when it would probably be able to dig itself out. In the north of the Malay Peninsula I understand that the pits used were lined with round jungle rollers of hard timber so that there could be no question of an animal's being able to dig himself out, but I have never seen any signs of lining to any pit in Pahang, where most of the pitting look place. In selecting the locality for a pit hard soil was searched for and generally the pit was made on the side of a hill along which ran a game path. Every particle of earth removed from the pit was carried away for some distance and no trace of it was left near the spot. I think this was done more to remove the scent from the earth in which the poachers had been working than to avoid the chance that the rhinoceros would notice a change in the landscape. A fascine of jungle saplings would then be made and placed over the pit. This was covered up with earth and leaves until it looked exactly like any other part of the game trail.

I do not think that the poachers visited the pits very often, the extreme sensitiveness of the rhino's nose making it imperative that as few visits as possible be made. But the poacher was satisfied if his work was good enough to assure a capture. From what I have gathered the wretched animals often starved to death and under such circumstances only the horn would be taken.

Although the pit was the commonest and the most deadly method of capture other methods were adopted. One was a platform made in a salt lick, but this, I believe, was not very satisfactory, because there were then no electric torches, and a rhinoceros seldom came to a lick during the day. The *belantek*, the spring bamboo or steel spear, was sometimes used, but was not so certain as the pit, although some other animal, a deer or a seladang, might be added to the bag.

The tracking of rhinoceroses was seldom undertaken by poachers, although an experienced hunter like the Datok Raja never used any other method. In fact he told me that when pitting began in the Negri Sembilan where he lived he gave up hunting rhino in disgust. He complained bitterly that pits very soon drove all the rhinos out of the district and he described with scorn the methods of people who were capable of getting a rhinoceros only by digging a pit for it. The tragedy of the whole thing lies in the fact that *Didermocerus sumatranus*, one of the cleverest, most cunning, sturdiest and most harmless of jungle animals should be driven from the face of the earth by superstition and greed. For years, in Malaya, this rare mammal has been protected by laws which, being ineffective, are merely 'marks on pieces of paper,' with the result that nothing practical has been done to try to save it from its fate.

COMMERCIALIZED SUPERSTITIONS

There has been for many decades in Malaya a demand for horns and other parts of the rhinoceros because such articles command high prices from Chinese shopkeepers and others. In fact I have known of Chinese who financed poachers, or who were willing to give them credit for a horn not yet obtained. In Northern Pahang, the largest and the least developed of the Federated Malay States, a tremendous amount of destruction was done to the rhinoceros population at the beginning of this century despite the fact that from 1896 there was a law in Pahang making it a punishable offence for any person not licensed to capture, kill or wound any rhinoceros. But no one was either licensed or punished; the poachers were not hampered in any way by an enforcement of the law; and the inertness of the Government was a contributory cause for the disappearance of one of the most interesting and characteristic of Malayan animals.

That the number of rhinoceroses must have been large is confirmed by the numerous trails made by them. A rhinoceros path is different from that

of an elephant, being narrower, because the rhino's footprints continually overlap. Thus they wear a deep furrow down the middle of the path when the track is in steep country. I have seen leading down to a wallow a trail that was 6 to 7 feet deep and much too narrow for an elephant to use. But the most astonishing trail I ever came across was in limestone country. Here there is a huge limestone massif, 2000 feet high, which was often circled by rhinoceroses when travelling that way. In this case a trail passed between two large limestone boulders, both of which were well polished for a height of about three feet. These boulders rested on bed rock—limestone—and in this bed rock the trail had been worn down a few inches. How many thousands, nay, tens of thousands, of rhino's feet must have passed along that trail! None pass now, because there are none to pass.

Parts of the rhinoceros's body have been used since ancient times for magical rites or as medicine. This has been the main incentive to the hunting and killing of these animals in Asia. In Malaya the rhinoceros's horn is the chief attraction, Chinese being willing to pay as much as £2 (U. S. $10) or even more per ounce for the horn or any part thereof. The dried blood is also a marketable commodity, fetching 5 shillings (U. S. $1) a pound. It is collected and dried on paper, brown paper for preference—it weighs more—then dried over a fire, the resulting blood-soaked paper fetching the above price. But almost all parts of the body are considered valuable medicine of one sort or another, even the contents of the small intestines before they have been evacuated have a value to the medicine seller. The skin, roasted like pork crackling, is considered a great delicacy. The horn is purchased by Chinese almost solely as an aphrodisiac; it is considered as an infallible sexual stimulant. Whether the effect of taking powdered rhinoceros horn in one's tea or otherwise is psychological or physiological it is difficult to determine, although it is not impossible that the powdered horn has some irritant effect on the generative organs and so produces a sense of increased virility. On the other hand substitutes have been used as the following incidents show. Some years ago throughout Malaya imitation rhinoceros horns made from buffalo horn were hawked around the country by Chinese vendors who sold them to the Chinese medicine shops that are to be found in every small village. These imitations were good efforts to represent a rhinoceros's horn to anyone who had never seen the real thing, and they went like hot cakes. The Chinese medicine-shopkeepers knew, of course, that they were not rhinoceros horns, but the ignorant Chinese laborer did not.

Among other powers attributed to rhinoceros horn are the following: A deep seated thorn can be extracted by rubbing the sore part with a rhinoceros's horn; a severe stomach ache or any other ache can be relieved immediately by the application of a rhino's horn to the affected part, and so on. These legends persist and so long as they persist and no one makes

any serious attempt to preserve the rhinoceros for posterity, *Didermocerus sumatranus* is doomed.

POSTERITY

What will posterity say of the present generation which is allowing, in many parts of the world, the fatal progress of the extermination of species, while professing an anxiety to save such species for future generations? In the new Wild Life Protection Act of 1936 in Burma, which might be considered as the last word on wild life protection, the killing, taking, importation or exportation of rhinoceroses or any part thereof, is prohibited, although there is a provision to enable the local government to give special licences for scientific purposes. This sounds as if the rhinoceros was very well protected, but unfortunately a proviso has been inserted in the Act which reads as follows:

'Provided that it shall not be an offence for any physician or druggist to possess or sell or for any person to possess for private medical purposes rhinoceros blood or any preparation thereof . . .'

How anyone can become possessed of any part of a rhinoceros when all killing and hunting of that animal is prohibited, when all import of the animal or any part thereof is prohibited, and still keep within the law, seems problematical.

The only hope that remains for rhinoceroses in Malaya, and I think I may add in Burma, to save them from complete extinction, is to constitute inviolable sanctuaries in their own habitat where a suitable environment is known to exist. These sanctuaries must be properly guarded and freed from human activities, and severe penalties should be provided for any breaches of such laws as are enacted to make these places real refuges for the animals in them. There must be no loophole in the Act such as there is in the Burma Act. Whatever the superstitions that may be connected with the rhinoceros, it must be recognized that these beliefs have brought all species of the Asiatic rhinoceroses to the verge of extinction, and unless steps are taken to make it practically impossible to continue to commercialize these beliefs then we must realize that we are impotent to save any of these creatures from extinction.

Sunlaws, Bukit Betong, Kuala Lipis, Pahang, Federated Malay States.

HABITS OF THE SOUTHERN SEA OTTER

By Edna M. Fisher

The southern sea otter, *Enhydra lutris nereis* (Merriam), formerly occurred in considerable numbers off the coast of California. Excessive and non-selective hunting by the Russians, English, and Americans eventually reduced the animal to virtual extinction not only along the California coast but throughout its entire range. Since 1915 only occasional reports of live otters have been made by the fishermen working out from Monterey. Never have otters been reported off the California coast in any numbers.

On March 19, 1938[1] a herd of sea otter appeared off the mouth of Bixby Creek (Mill Creek on most maps), Monterey County. This is about 15 miles south of Carmel-by-the-Sea. The unusual behavior of these strange animals immediately caused much excitement among the local residents. No one seemed to know definitely what they were. This herd was estimated to contain 400 individuals when first seen, but that number seems quite improbable after more careful study and frequent counts. A week or two later the count was well below 100 and at no time has it exceeded 94. The herd remained off Bixby Creek for almost two weeks and then quite suddenly departed northward around the point to a double cove protected from the currents of the open ocean by a number of large rocks. It is said that the otters were frightened by a killer whale, *Orcinus rectipinna* (Cope), which dashed in toward them and caused them to depart rapidly northward.

My personal study of this herd of otters began on April 14 and has continued to September 6 with only a few interruptions. The otters have been observed at all times of the day and many times for almost the entire day, from dawn to sunset. The usual number to be seen together at one time is generally between 60 and 80. The number varies considerably with the time of day and with their feeding habits.

The otters made the double cove their home or headquarters until July 4, foraging for food always to the northward. This cove was an ideal spot for observing them and their presence attracted the attention of many people. There seemed to be a noticeable tendency among the visitors to throw stones at the otters from the top of the cliff just to see them scatter. It was reported that someone threw firecrackers over the cliff at some time on July 4, just for the fun of it. Some people descended the narrow trail to the beach to take pictures of the otter. At first this did not bother the otters very much; but with the increase of human activities on the cliff and trail they became increasingly sensitive and would dive and disappear for a half day at a time at any unusual disturbance on the shore.

[1] This date was supplied by Mr. Charles E. Mayfield, Warden of California Fish and Game for this region. His friendly coöperation has been most valuable throughout this study.

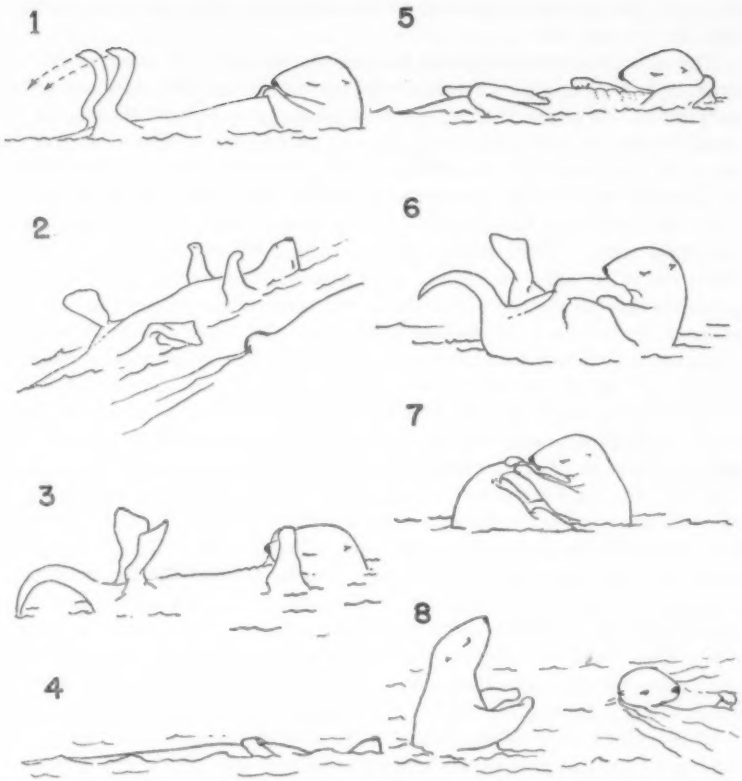
About 8 o'clock on the morning of July 4 the herd again moved north for a distance of about two miles where they came to rest on the outer margins of a large kelp bed off Notley's Landing. Only a few returned to the former cove, and from July 14 on no otters have been seen there. The general tendency of the animals seems to be to move slowly northward from one cove and kelp bed to another as the food supply in each region is depleted. The feeding is generally to the north of where the herd is located, seldom is an otter seen feeding any distance south of the main herd location.

On July 27 and 28 two abalone tender boats, with their accompanying small boats, came to anchor off Notley's Landing, one tender just south of the herd and the other immediately north of the kelp bed usually occupied by the otters. The small boats are motor driven and cruise back and forth, stopping frequently so that the diver can go down and get abalones. The presence of these boats was sufficient to cause the otters to scatter in all directions, mostly to the south, or out to sea; a few came closer to shore to hide in the mass of long tubular kelp. The Japanese abalone fishermen decrease the number of abalones available and since abalone is the main part of the diet of the sea otter there will be keen competition in the future. With the departure of the abalone boats for the Monterey market the otters began investigating the section. Later in the day they slowly reassembled in their favorite kelp beds. They have remained here ever since with only slight disturbances now and then. On August 14, four large killer whales were sighted swimming by a short distance west of the otters. The killer whales did not sense the presence of the otter and went by. If the otters realized the nearness of their enemy they did not show it; they remained floating peacefully as usual.

RESTING

When resting the otter lies on its back among the kelp or in quiet water and may assume any one of numerous positions. The most common position is with the head up and the chin resting on the chest, the small paws or hands folded across the chest (fig. 1). The lungs are partially filled with air so that the chest extends above the water level. The legs and feet stick up in the air rather stiffly and the tail floats on the surface, sometimes waving slowly sideways. Since the animals are usually headed into the current when resting, this slow movement of the tail helps them to maintain their position. The hind feet may wave back and forth in the air producing slow small undulations, which also help to keep the body in position.

Another position similar to the preceding is when they hold all four feet up in the air as if they had been wired (fig. 2). Often they place their paws over their eyes so that they can sleep during the daylight (fig. 3). Less often the paws are folded over the chest and the head is laid back in the water so that not much more than the nose is exposed (fig. 4). When the head



1. Asleep, feet flopping, causing a slow undulatory movement of body.
2. Asleep, all four feet held up in the air as if wired in place.
3. Asleep, paws resting over bridge of the nose, tail raised more than usual.
4. Asleep, complete relaxation with body awash.
5. Resting, with all four feet scratching different spots. Skin on chest is always wrinkled when the head is held up.
6. Cleaning the feet. Otter usually does pinwheels over and over in the water while in this position.
7. Cleaning the tail. Also does pinwheels during this process.
8. Otter rises up and shakes the water from the head and chest much like a wet dog. The other otter swims by sideways.

is so relaxed the rest of the body is also relaxed, and the legs are flat out on the surface and the entire body is awash. This complete relaxation gives the impression of a dead otter barely afloat. Frequently the otter will

relax the feet so that they rest on the abdomen, either parallel or crossed (fig. 5).

The otter may remain quietly floating or resting in one position for some time, even long enough for part of the fur to dry, but this does not happen very often. It seems that an otter no sooner gets relaxed than some spot needs scratching; and more often than not there are several such annoying spots so that each foot scratches or rubs at a different spot, seemingly in an attempt to dislodge parasites. Exactly what these parasites may be I do not know; but the behavior of the otters seems to admit of this explanation only. While scratching the otter frequently rolls over several times either to right or left. The exposed areas seem to have the most parasites and to require almost constant scratching. Sometimes an otter seems to be having a fit, dashing madly here and there and kicking up the water in all directions and turning over, scratching and biting as it frantically tries to get rid of the tormentors. Such a disturbance may last for three or four or even more minutes; and when relief is gained the otter will return to the main herd to rest and clean its fur. The parts that require the most attention are the head, the arms, the entire ventral surface and the legs, and especially the big webbed feet, which are fully furred on both surfaces (fig. 6). The tail comes in for its share of attention and is frequently scratched, licked as a cat would do, and combed or bitten with the teeth (fig. 7). The back needs the least attention since it is under water most of the time and seems to harbor few parasites. The otters roll over so that the back is out of the water, and then partially rising out of the water shake themselves much as a dog does when wet (fig. 8). Then by muscular action the skin moves like ripples up and down the back, and if this is not enough one of the hind feet is brought up and the back is thoroughly scratched.

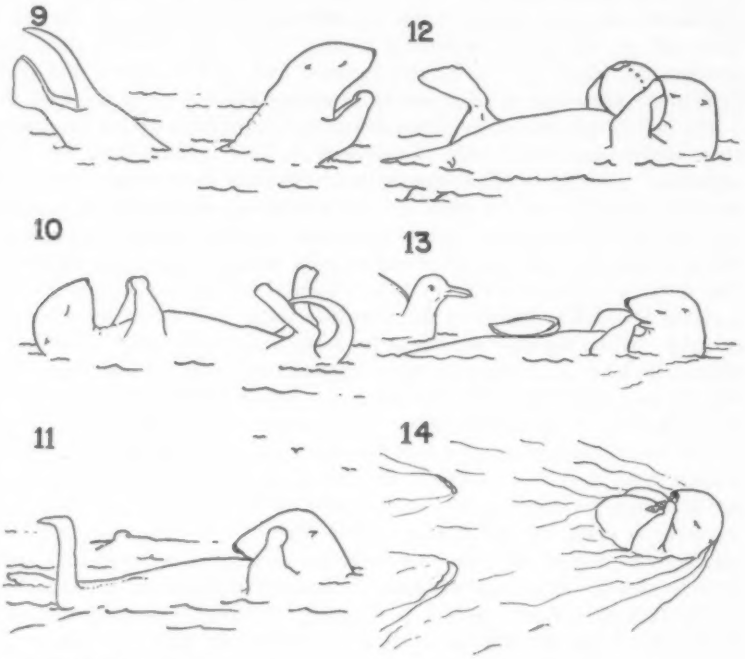
When rolling over while resting they assume various positions. With head and paws, as well as the legs and tail held well above the water, and only the middle part of the trunk submerged, the otter rolls over and over slowly without touching the head, arms, legs or tail to the water (fig. 9). They do this frequently and with the greatest ease; so smoothly is it accomplished that it has been impossible to figure out just how it is done.

Frequently they wrap strands of kelp about them or fold their arms over a strand to prevent drifting ashore while they sleep or rest.

The hind legs are commonly held straight up in the air at right angles to the body, usually both at the same time although occasionally an otter is seen with one leg sticking up and the other floating flat on the surface of the water (fig. 10). This latter position is sometimes seen in a swimming otter, the one leg furnishing enough power for locomotion. An occasional otter may be seen with both legs relaxed and the tail standing up so that it resembles a cormorant (fig. 11).

The otters spend a considerable amount of time resting and cleaning their fur. This is especially true on days when the water is calm. When the

water is rough they are in almost constant motion and when there is calm water they are indeed ready for a rest. The rougher the water the longer the rest periods when the water does become calm. The entire herd was observed one morning to rest for over two hours following two or three days



9. Resting and turning.
10. Resting with head back, feet and tail up and the hands held as if praying.
11. Resting with the paws over the eyes to keep out the light. Tail held up in such a way that it resembles a cormorant's neck and head, while the legs float on the surface.
12. Eating an abalone.
13. Abalone shell rests on the abdomen while the otter chews. A hungry gull follows the otter expectantly.
14. Otter is swimming slowly while finishing a crab.

of very rough water. This was an unusually long period of inactivity for the herd as a whole.

FEEDING

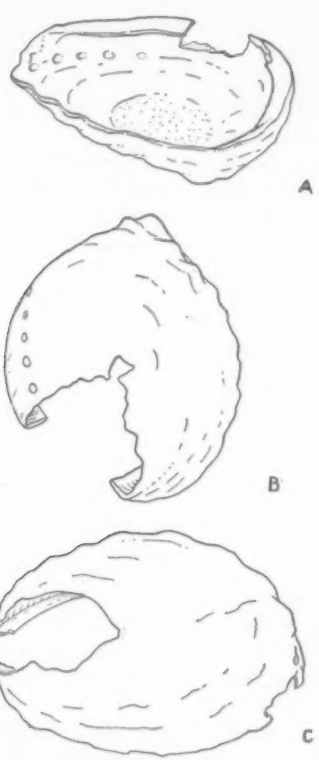
Next to resting and cleaning or scratching, the search for food seems to be the sea otter's most important activity. The early morning hours find the animals busy hunting for food; when satisfied they return to the kelp

bed to rest. At feeding time the otters scatter in all directions (in the case of this herd usually northward); and it is every otter for his own supply, with some exceptions to be noted later. After breakfast they rest and clean until midday (10 to 2 o'clock) when again they all seem to be in search of food. The afternoon is spent by the herd in resting, sleeping, scratching; sometimes some are mating, a few are fighting; and occasionally the whole herd will go through a swimming routine. The next feeding time that involves the whole herd is usually between four or five o'clock and dark. Individual otters can be seen feeding at almost every hour of the day.

The individual otter swims along either back up or belly up (or alternating these styles) until he reaches the desired territory. Here, from the back uppermost position he submerges without the least commotion. In diving the arms are folded on the chest and the undulating movements of the body and the powerful backward thrusts of the legs send the animal down rapidly. When diving for food the otter seldom goes straight down, but obliquely. The water is too deep for them to be observed far below the surface; only a string of bubbles indicates the direction taken and these are soon lost to sight. When the otter returns to the surface with the food it immediately rolls on its back, and, using its entire ventral surface for a table, eats whatever it has captured. The red abalone, *Haliotis rufescens* Swainson, is the mollusk most commonly eaten. The abalone shell is held up to the face by the two arms and great mouthfuls are torn out of it (fig. 12). If the portion is so large that the assistance of the hands is required to keep it in the mouth for chewing, the shell is laid on the chest or abdomen until the otter is ready for the next mouthful (fig. 13). I have never seen an abalone shell roll off the body even when the water was rough and the body entirely awash. After one mouthful is finished the abalone is picked up and more flesh is taken until it is all gone. Between mouthfuls the otter frequently clasps the abalone shell to its chest and rolls over and over, never seeming to mind getting a mouthful of salt water mixed with the food that is being chewed. It takes an otter about five minutes to eat a large abalone. Tidbits that cannot be nipped off are pulled off by one of the hands and then placed in the mouth. When the abalone is finished the shell is allowed to sink to the bottom. The otter may now join the main herd if its hunger is appeased; if not it dives for more food. Frequently a gull is seen riding the waves close to the feasting otter, waiting to pick up any morsels that may be dropped. Sometimes the gull gets so close as to annoy the otter, which may swim away fast enough to force the gull to fly to catch up; or it may dive and swim under water for some distance before coming up to eat in peace. Then the gull is left behind bewildered, but not for long. At times when the gull gets too close, the otter will kick or splash water in the bird's face in such a manner as to frighten it.

I have never observed one otter trying to take an abalone from another,

although the stealing of all other food materials is a common practice. This may be due to the fact that abalones are usually eaten far from the main herd and no temptation is offered. The abalones selected are large ones, as



15. Three abalone shells from which the otter ate the animals. These show the broken places characteristic of all taken by the otters. In A the break is 2¼ inches wide and 1 inch high. In B the break is 3½ inches wide and 2 inches high. In C there are two breaks, a small marginal one 2½ inches wide and ¾ inches high, and a larger irregular break that extends well into the shell and is about 2½ inches wide and 2½ inches high.

shown by the following measurements in inches of three shells retrieved soon after being finished: A, 8¾ inches long, 6¾ wide; B, 7⅛ long, 6⅝ wide; C, 7½ long, 6½ wide.

It is still unknown just how the otter detaches the large abalones from

the rocks with their small paws. They are most decidedly successful. It does not take an otter long to get an abalone off and bring it to the surface. One very noticeable thing is that each shell has a large piece broken out of one side (fig. 15). How this piece is broken out under water is still a mystery; perhaps by pounding with a rock, perhaps by the strong canine teeth.

When a sea urchin is brought to the surface it is eaten rapidly. A hole is bitten in the test and the internal structures are sucked or licked out in a very short time. The empty test is dropped or tossed away and the otter rolls over and dives again. All of the sea urchins seem to be very large purple ones, the exact species unknown to me.

Perhaps the otter brings up a crab on the next dive, and this, like the sea urchin, is devoured in a short time. It took one otter about five minutes to eat a very large crab. The crab's legs are pulled off and held in both hands; then eaten while the rest of the crab lies on the abdomen. When the legs are finished the body is eaten. It is hard to determine the species of crab eaten, but on two occasions the prey closely resembled *Lopholithodes mandtii*.

It is not an uncommon thing to hear a sharp clicking sound and then to locate its point of origin, perhaps in the midst of the herd or perhaps far from the main group. This sound is always made by an otter that is trying to crack open something with a very hard stone-like shell (fig. 16). The object that the otter has in its paws is too small to see—possibly it is some mollusk. The object is held with both paws and with full arm action from well over the head it is brought down hard on a piece of rock that rests on the otter's chest. These pieces of stone are brought to the surface at the same time as the food. It may take several severe blows before the object is cracked enough for the otter to get the food out. These rocks are not small but appear to be almost as large as the large abalones. When the otters roll over they hold both the rock and the food on their chest. This clicking sound is so distinct that it can be heard for some distance above the noise of the waves.

Some persons who have watched these otters think that they eat large mussels, but I have never observed one eat anything that closely resembled a mussel. The large mussels abound on the submerged rocks about here, and a large mussel is so much larger than an otter's paws that it could easily be seen.

Occasionally an otter may be seen nibbling on some kelp; the species is unknown. It is quite safe to say that kelp is not part of their regular diet.

Food stealing is a very common habit among the otters of this herd. An otter swims up to one that is eating and deliberately takes the food away from the other otter, then rolls over right there and eats it. The original owner gives up the food without a protest and turns over and dives for some more food and comes up some distance off. Rarely ever does an otter fight

to keep its food, but when it does the water flies in all directions. There seem to be some otters that are domineering over others and one of these that we have nicknamed 'grandpa' appears to be master of the entire herd. When this individual wants something to eat he takes it away from any otter nearby that is eating.

MATING

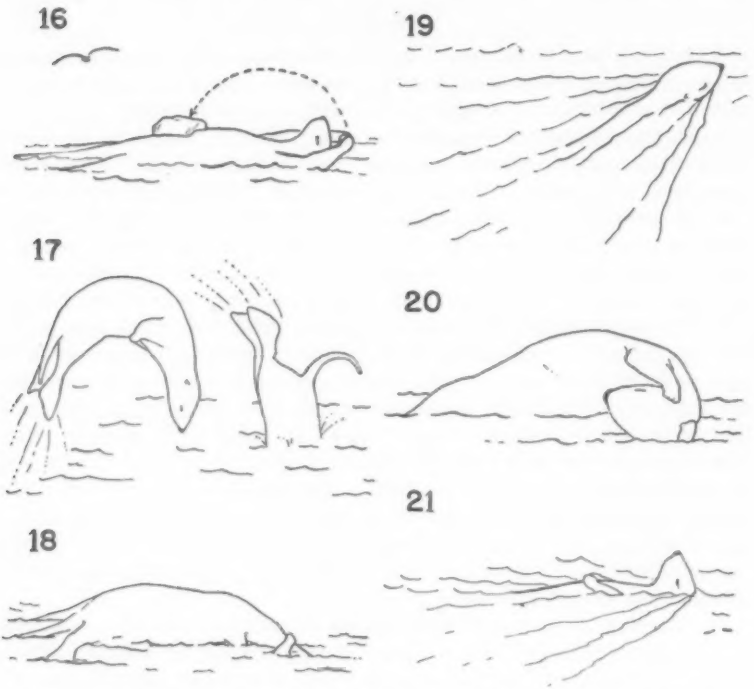
After much close observation I believe that most of the activity supposed to be playfulness is either fighting between two partly grown males or more often the splashing and struggling of a male and female trying to copulate. Courtship may be started by either the female or by the male; if by the female her attentions are centered on one male until the mating activities have been completed. Courtship is the seeking out of an individual of the opposite sex that responds positively to the smelling of the genital regions. Many times an otter was observed to rise up and give a too inquisitive animal a slap with the full force of the whole arm. The intruder usually departed forthwith. Attempts to mate were noticed on every day of observation.

In this particular herd it seemed to me that there were about three males to every female. Competition for females was keen. Usually there is no fight or interference when a male and female are attempting to mate, but there are some occasions when one or even two other males will pounce upon the accepted male. Then a fight ensues. In these fights there is much splashing about on the surface, diving and leaping far out of the water only to dive straight down again (fig. 17). Apparently the female leaves the vicinity until all is peaceful, when she is either sought out by the male or herself seeks him. It is almost impossible to tell the sex of otters that are completely relaxed but with the least activity the males appear to me to be easily distinguished from the females.

On calm days there is very little mating activity, only an occasional pair on the outer margins of the herd may be seen splashing, rolling and diving together. On days when the water is rough with many whitecaps on the outer ocean there is a marked increase in the number of mating otters and also a restlessness in the whole herd. Rough water seems to act as a stimulus to the reproductive instinct.

Much of the mating time is spent by the male in struggling to get the body of the female in such a position that copulation can take place. This is difficult in the rough water, with the constant movement of the swimming otters and their habit of rolling and turning over and over. The male grasps the female somewhere on the head with his teeth and then holds on tightly. He appears to have hold of her nose or chin, certainly not the skin of the back of her head or neck as might be expected. If he can maneuver so that the two bodies are parallel he then grasps her with his arms around her neck or chest and tries to hold her tightly (fig. 18). This process is tried many

times until finally the male gets such a hold on the female that her back rests against his ventral side and then with turning he manages to hold her uppermost and mostly out of water. In this position the male is completely submerged and the head of the female is held under water. Usually the chest



16. Otter cracking some food object on a rock on its chest; note full arm action.
17. Leaping out of water and diving straight down—usual type of leap.
18. Position of the female's body that seems to be a preliminary one during successful mating.
19. Otter swimming rapidly.
20. In pursuit of parasites and rolling madly over and over in the water.
21. Swimming in the usual manner, slower than when the back is up but making steady progress. They do more swimming in this position than in any other.

and abdomen of the female are bowed up high out of the water. While in this position the male tries repeatedly to complete the copulation. This is not the only position during mating but by far the one the most frequently seen. Perhaps a big wave comes along just then and the female gets off balance and rolls over and then the whole process has to be repeated. Some-

times it is the need for air that causes the male to release his hold on the female's head and then they begin activities all over again. At other times they seem to get worn out from the constant struggling in the rough water and mutually agree to a rest period, at which time they may or may not join the main herd.

It is the partly grown males that are the most active sexually. On days when the water is rough they can be seen carefully going over the entire herd in search of a receptive female. Sometimes they seem almost frantic as they swim over, around, and under the other animals in the herd. Many times it was a female that kept annoying the males until she found one that was responsive to her attentions. When a receptive mate is found the pair proceed to the outer margin of the herd to continue their activities undisturbed. On rare occasions a female otter will elude the male and dive under and come up to rest in the midst of the herd only to be singled out and maneuvered to the margin of the herd again.

Many times pregnant females were reported in the herd or resting near by and even the birth of a baby otter was described by local residents or passers by. But each time upon close observation the 'pregnant females' proved to be resting males inflated more than usual. And to date no young otters have been seen in or near this herd by any reliable observer. The supposed 'pups' are evidently the air bladders or floats of a species of kelp which the otters frequently clasp to their chests while sleeping.

The sex of an adult sea otter is usually not very difficult to determine when the animal is lying on its back. In the male there is a decided ridge, caused by the underlying penis, extending in the mid-ventral line from the pubic symphysis for almost half the length of the abdomen. The penis in the sea otter is long, sharp-pointed, and of surprising diameter. The unsheathed glans is of a bright red color and is very easy to see from some distance. Frequently resting males can be seen with the penis protruded along the abdomen; and there is a large, slightly curved baculum that makes the "penial ridge" more conspicuous.

SWIMMING

The otters have various ways of swimming and these may be grouped into two major groups. First when they are going somewhere in a hurry, and second, when they are traveling but not in a hurry. For the first type they fold the hands or paws on the chest and turn with their backs uppermost and then glide through the water rapidly with the greatest of ease and with remarkable smoothness (fig. 19). The legs and feet force the undulating body forward with powerful backward strokes. The legs may work together or alternately. Often both these methods are used, frequently alternated. The leg is drawn forward so that the knee is close to the body and at the same time the foot is held with the toes close together and the webs folded. On

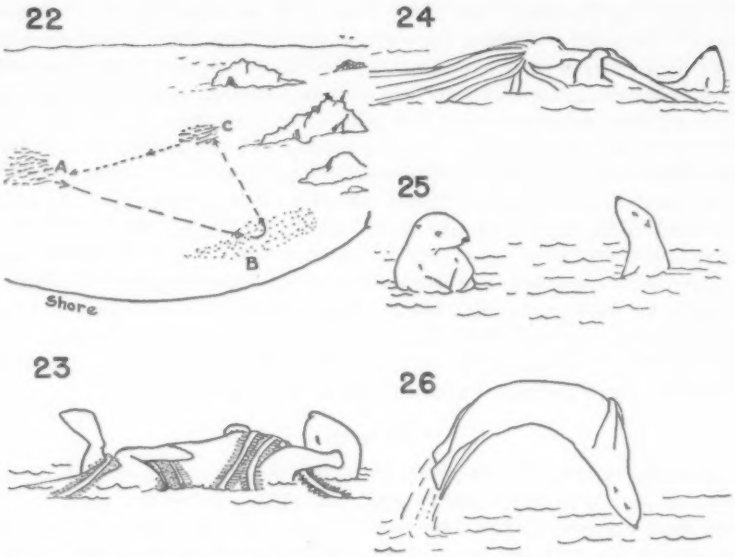
the backward thrust the toes extend out so that the web is stretched to its full breadth, thus offering a larger surface in resistance to the water. The backward kick may be lateral or latero-ventral.

The undulating movements of the body are very noticeable and graceful when the otter is traveling with the dorsal side uppermost. The otter's head and back are out of water and the next instant he is completely submerged only to come to the surface for the distance of a few feet. This movement resembles that of the sea lion except that the time on the surface is longer and the period of submergence much shorter. The otter usually dives when crossing or encountering waves, but sometimes he fails to do this and the wave carries him back for some distance. When swells come along the otter swims upon their surface as smoothly as if they were not there. Often when traveling rapidly the otter will appear to take time out, and rolling over and over, thereby swimming in a spiral, he will scratch diligently along his chest or neck or wherever a biting parasite may be (fig. 20). If the parasite is causing too much trouble the otter will stop swimming and scratch until relieved and then continue on his way. The otter can swim completely under water for considerable distances when pressed by enemies or when badly frightened.

Leisurely swimming varies with the moods of the individual otters, and is of several different styles. If the water is calm enough the animals seem to prefer to float with their legs and feet held stiffly up in the air. When watching them resting on the water in this position it is always surprising to realize that some of them are actually moving slowly away against the current and without any change in position. In such a case, by careful observation, one may see the tail slowly and regularly moving in the water both sideways or in a circle; and it is this power furnished by the tail that moves the otter. Sometimes the tail is aided by the raising of the entire rear end upward, but not out of the water, and then letting it down rapidly. Occasionally as if to add a little more power and speed an otter lowers one leg into the water and with slow deliberate strokes helps to push its body along. The other hind leg remains sticking up in the air (see fig. 12).

The arms and hands are never used as a means of locomotion nor when diving. The arms and hands or paws are either folded over the chest or held aloft like the legs. Many times the paws are held together out in front of the chest as if in prayer. This is done frequently while the animal is swimming slowly but more often while it is resting and rolling (see figs. 9 and 10).

Not only do the individual otters swim about separately from the herd but there are swimming routines followed by the herd as a unit. One day one such routine was timed as closely as possible (fig. 22). The herd was resting quietly in a large kelp bed in the center of the cove when suddenly and for no apparent reason all the animals turned over and dove under water with somewhat of a splash. The herd came up to the surface close together and some



22. Diagram to illustrate the swimming routine of the triangle. A, the center bed of kelp; B, the night kelp bed near shore; C, the kelp bed out in the current and to the northwest of the center bed of kelp.

TABLE OF TRIANGULAR ROUTINE

June 9, 1938, P.M. Cool day, strong wind with high dense fog, and rough water.
2:00. Resting at A, washing, scratching, sleeping, and rolling.
3:00. Herd dives, swims to B, then to C, from here they drift to A.
3:25. Have reached A. Dive immediately and go to B, then C, then drift.
3:48. Have reached A. Rest.
3:55. Herd dives, goes to B.
4:00. Herd reaches B, swimming leisurely, and starts for C.
4:02. Herd reaches C, start drifting on current to A.
4:10. Have reached A. Immediately dive and swim to B, then to C, then drift.
4:30. Have reached A. Dive and go to B, then C, then drift to A again.
4:45. Have reached A. Rest.
4:55. Half of herd swims to B. Here relax and clean, then go north to feed.
5:00. Rest of herd swims to B, rests and then goes with the others to hunt food before night comes.

23. 'Grandpa' all wrapped up in kelp has to scratch several places and eventually gets unwrapped. The usual way of getting ready for the night.

24. Sleeping in the day time in the tubular kelp, the otter clasps a 'stem'.

25. On guard, two otters rise up to look around and sniff the air for danger.

26. Leaping out of water. A style that is seldom seen without the closest observation.

distance from the center kelp bed. They all swam rapidly at first but soon slowed down after reaching the surface, where they swam along some on their backs, others with their backs uppermost. They varied their positions often. Reaching the east kelp bed, they investigated it and then without resting headed westward to another point where they came to rest with their feet up in the air as usual. And so, resting and scratching, they drifted peacefully with the current which carried them back to the center kelp bed, thus completing a triangle. They remained in the center kelp bed for a while and then repeated this routine of the triangle. During this activity the individual otters were never very far apart. This triangular routine may be repeated frequently during most of an afternoon, the herd finally scattering to hunt for food before darkness overtakes them. So far it has been impossible to find out just what the signal is that directs these activities. Sea otters have a voice and make very distinctive sounds; but so far no sounds have been heard associated with this particular type of activity.

SLEEPING

After the evening feeding period the otters one by one come back to the kelp bed in which they usually spend the night. In general most of the herd have returned to this kelp bed by dark. At first they swim in and out among the kelp and then roll over and clean up for the night. Before going to sleep many of them will roll over and over in such a way as to wrap several strands of kelp around them. The pelvic and chest regions are the places where the kelp is wound most often. This habit of wrapping up in kelp prevents the otter from drifting away from the herd during the night. Sometimes an otter will be settled for the night carefully wrapped up in kelp and then several parasites will start biting. In its strenuous efforts to scratch all the places the otter is soon completely out of its kelp wrappings and has to wrap up again (fig. 23). The members of the herd usually sleep as close together as possible, thus forming a very compact mass.

The kelp bed used for sleeping is in general used night after night unless the changing tides make it impossible. Also this kelp bed is seldom used in the daytime for a resting place. The kelp bed in this cove that was used at night could not be occupied during very low tides because it was too close to shore and the bottom was exposed at low tide. At the time of the very low tides the otters seemed to prefer to spend the night in the center bed of kelp.

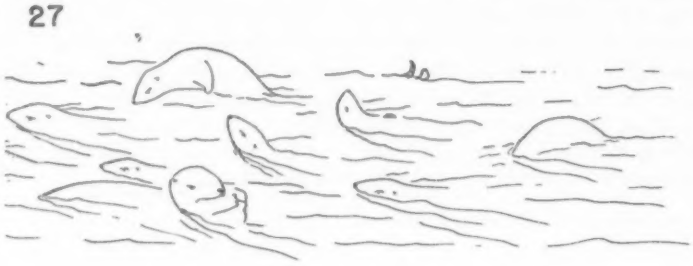
They yawn frequently and much as a cat does. So far nothing has been observed that compares to stretching—perhaps they exercise all parts so evenly that stretching is not necessary.

When they are asleep among the long tubular kelp they have more difficulty in maintaining their position than in the ribbon-like kelp. The long leaflike processes are not so easy to wrap around the body in a way that they will

stay for any length of time. When in this kind of kelp the otter frequently clasps its arms about the 'stem' near the float and then holds on tightly (fig. 24). The otters are very difficult to see when sleeping in a bed of tubular kelp unless they have their feet sticking up in the air.

ON GUARD

When a signal is given that there is an apparent danger most of the herd rolls over and dives and is off with a terrific splashing, swimming rapidly and under water for some distance before emerging. One or two or even more individuals may remain behind to investigate. These guards are always far apart bobbing up here and there looking and listening for the cause of the alarm. They swim under the water for a distance only to appear suddenly standing upright with more than half of the chest above the water (fig. 25). After some time, anywhere from half an hour to most of a day, the herd re-



The herd swimming.

turns to the original kelp bed or takes up quarters in another some distance from their former place. When the otters were frightened away by people who went down on the beach they were so alarmed that they seldom returned to the cove until after dark, and then the herd acted normally as if nothing had occurred to scare them. After the repeated disturbances on July 4 they departed to a new location for their permanent headquarters. The near passage of any motor driven boat causes the herd to disappear in all directions into the kelp. Sea otters are very sensitive to any unusual noises either from land or sea and are ready to flee at the first alarm.

VOICE

The otter has a voice and makes several distinct sounds loud enough to be heard two or three hundred feet or more away. Distance made it impossible to determine if there were any low sounds uttered such as signals for the herd or sounds used between individuals.

The following sounds were heard many times and are interpreted as the

circumstances seemed to indicate. *Er-er-r-r-r*, a deep sound repeated at different lengths. It appeared to be like a growl, possibly given by some old male; at least it served to ward off the close approach of another individual. *Ar-wak! Ar-wak!* These sounds are uttered when one otter has a too painful hold on another. It seems that it is one of a mating pair that makes this sound as much as to say 'quit, it hurts'; at any rate the other otter generally lets go after this complaint and they both come up for air. *Meo-ak!* is another sound heard and perhaps more often than any of the others. It seems to be associated with a painful bite received from another otter. This particular sound can be heard for some distance, and it is recognizable even though the otter is far off out of sight under a cliff. A long drawn out sound that is almost a squeak sounded like *E-e-e-e-e-e-e-eh!* This sound seemed to be caused by a nip from a passing otter.

The otters live together peacefully and happily and there is very little fighting. Also there is very little that might be interpreted as true play. As far as it has been possible to observe, fighting occurs only when more than one male is in pursuit of a female, or occasionally when one is robbed of food. These fights are fierce and there is a terrific splashing, the animals leaping clear of the water (fig. 26) and diving and dashing at each other. The speed with which they move makes it impossible to follow their actions with any degree of accuracy. The fights over food are not serious since only two individuals are concerned and the dispute is soon settled.

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DISTRIBUTION OF MAMMALS IN THE JAPANESE EMPIRE

By Nagamichi Kuroda

From a zoögeographical viewpoint, Japan extends in the north to Cainogaea, and in the south, the south end of Amami-Ôshima Island enters Mesogaea. The dividing line of the two zones is without doubt at the Watase's Line of Shichitô-nada. The area north of this line belongs to the Palaearctic Region and the area south of the line to the Oriental Region. Japan comprises a chain of three islands, a unique phenomenon that can not be seen outside of Asia. It extends from south to north a distance of 2,589 miles; its longitude east to west covers 37 degrees, and its latitude south to north 29 degrees. Furthermore, the warm current from the southwest reaches the central part of Honshu, and the cold current comes from the north. In climate the country is in the frigid, temperate, and tropical zones. In Saghalien the temperature sometimes exceeds 30 degrees below zero C. Then, at the same season, in the southern part of Formosa, it may be 20 degrees C. Thus the difference in temperature at the same time may be 50 degrees. In the hottest part of August, the difference is still 25 degrees. Even in the interior district, the difference of temperature between mountain regions and plains is considerable. The area of Japan, excluding Korea, is 450,000 square kilometers, or one thirty-third of the world's total area. In mammals, the country has one thirty-fifth of the entire number of species of the world, much more than in England. The number of species in a certain area is believed to be controlled by climate, amount of rain, vegetation, and the size of the area. Japan's rainfall is heavy, and the soil is fertile, but the area is small. According to Prof. Watase, the number of animals is quite large because of its nearness to the great source of animals. This is because the three islands of Japan are located near the three developmental zones of animals, Central Asia, the Oriental Region, and Siberia. To understand the distribution of mammals in Japan it is necessary to know the mammals in each island of the country and also the geologic relation of those islands with the continent.

Wallace published a book entitled "Island Life" in 1880, and in it he divided islands into two groups according to the condition of animal distribution. One group is continental islands, which are mainly formed of sedimentary rocks and are located in shallow seas not far from the continent; their animals are not much different from those on the continent. Hokkaido, Formosa, England, Java, and Sumatra belong to this group. They have been connected with the continent in the course of geologic time. The second group comprises oceanic islands, having no close relation to continents, mainly composed of coral reefs, or the result of volcanic action. Such islands have few indigenous mammals. The Seven Islands of Izu, Volcano Islands, Marianna

Islands, and the Hawaiian Islands belong to this group. Japan has both continental islands and oceanic islands.

Prof. Watase (1912) wrote substantially as follows: The Kuriles and Riu Kiu islands have a fauna derived from that of Japan and have no relation with the continent. There are two types of continental islands, the ancient and the recent; Japan belongs to the recent continental type. The recent continental islands became islands with the sinking of the surrounding areas, consequently all living things were forced to gather there. England is an example of this, as is shown by the shallowness of the surrounding sea (less than 100 fathoms). Thus the animals of such islands are the same as those on the nearby continent. The other kind are called ancient continental islands, Madagascar Island being an example, on which live Lemuroidea (Prosimiae) that are not found in Africa. That is to say, the strait between Africa and Madagascar is very deep (generally above several hundred to a thousand fathoms deep). The depth of the sea near Japan reaches 8,000 m. This is called the Tuscarora Deep. There is a deep sea by the Riu Kiu, of 7,000 m. The depth of the Okhotsk Sea is about 3,000 m. and even the Japan Sea is more than 3,000 m. deep near Vladivostok. The Yellow Sea is comparatively shallow. The Shichito—nada where the above mentioned Watase's Line is located is a deep sea of 1,000 m.

Zoögeographically speaking, mammals originally existing in islands are more important than those that have migrated from other areas. Among the large animals living at any one time on the vast area of the adjacent continent, there are many that were defeated in the struggle for existence when confined on small islands and consequently became extinct. Judging from the petrified bones and teeth found in Japan, it is clear that three species of elephants and two species of rhinoceros reached these islands, but it is not known whether they became extinct because Japan became insular or from other causes. On the other hand, there occur species which have almost entirely disappeared on the continent, but are left on islands which have become their places of refuge. Coming to islands, it is a common fact that although the animals underwent no other changes, they have become smaller in size. Deer and boars are such examples. There is an example of this in the Riu Kiu Islands. *Cervus nippon* var. *keramae* (Kuroda) is a deer that was imported from Satsuma to the Kerama Islands, and in the course of time, its skull and antlers have decreased in size. The breadth of the nasals is reduced to less than 25 mm., while that of the typical form is more than 30 mm.; the antlers have special tubercles. I believe it is the same species as found in Japan, but I desire to treat it as a variety. It is said that antlers of the deer of the Gotô Islands have many tubercles. The wild boar found in the Amami-Ôshima, Okinawa, Ishigaki, and Iriomote islands is much smaller in size of body and of skull compared with those in Japan proper. This is called *Sus leucomystax riukiuanus* Kuroda, and is recognized as a subspecies of the Japanese species.

The above is a general outline of the distribution of the mammal fauna of Japan. The outline of its distribution from the northern to the southern parts will now be elaborated.

MAMMAL FAUNA OF SAGHALIEN

In the opinion of Okada and Koba (1931), Saghalien belongs to the Siberian subregion, and as regards the distribution of the mammals, it is in the Boreal Region proposed by Prof. Watase and Mr. Kishida. This region has distinct genera, including *Lynx*, *Gulo*, *Moschus*, *Rangifer*, *Sicista* and others. Also it has five species of *Sorex*, *Sciuropterus russicus athene* Thomas, *Lepus timidus orii* Kuroda, *Martes zibellina sahalinensis* Ognev, *Vulpes vulpes schrencki* Kishida, *Ursus arctos beringianus* Middendorff, and others. It is also said that *Neomys watasei* Kishida (1903 *nom. nud.*) is found in Saghalien. All these animals can be recognized as species of the Siberian subregion. There is no genus peculiar to Saghalien, but among the species peculiar to that island are *Sicista caudata* Thomas and *Neomys "watasei."* As I have not seen a specimen of the latter species, I can not say whether it is worthy of recognition. As special subspecies there are *Sciuropterus russicus athene* Thomas, *Lepus timidus orii* Kuroda, *Martes zibellina sahalinensis* Ognev, *Vulpes vulpes schrencki* Kishida and *Sorex daphaenodon daphaenodon* Thomas.

MAMMAL FAUNA OF THE KURILE ISLANDS

Special species in the northern half of the islands are *Sorex megalotis* Kuroda, *Sorex leucogaster* Kuroda, *Sorex daphaenodon orii* Kuroda (all three on Paramushiri Island); *Microtus uchidae* Kuroda (indigenous to Araido, Shimushu, Paramushiri and Onnekotan islands and introduced on Ushishiri and Matsuwa islands); *Mus kurilensis* Kuroda (Shimoshiri Island, central Kuriles); *Vulpes vulpes splendidissima* Kishida (central and northern Kuriles to Paramushiri Island), or six in all. In the southern part of the Kuriles there is only *Eutamias asiaticus okadae* Kuroda (Chachanupli Mountain, Kunajiri Island). Of mammals found in the Kuriles, eight forms (including subspecies) are common to the Kuriles and Saghalien, and the other eight species are common to the Kuriles and Hokkaido. In the southern Kuriles (except in Saghalien) and north, there are found only 10 species. Also on the Kurile Islands there are many Kamchatkan animals belonging to the Siberian subregion; in the central and northern islands, there occur: *Ursus arctos beringianus* Middendorff, *Thalarctos maritimus* (Phipps), *Alopex lagopus lagopus* (Linnaeus), *Mustela erminea kanei* (Baird), *Martes zibellina kamtshadalica* (Birula) and *Clethrionomys rufocanus rufocanus* (Sundevall). As already reported by Kishida (1930) there are not found in the northern part any elements of the Chino-Manchurian fauna.

On the basis of the mammal distribution, the Kurile Islands are divided into the southern and northern parts. The line dividing the two parts is to

be drawn, according to Okada and Koba (1931), between the Shimoshiri Island and the Uruppu Island, South Kuriles, through the North Uruppu Strait. The region north of this line is to be called the Kamchatkan Division and that south, the Hokkaido Lowland Division. This is practically in agreement with the opinion of Marquis Yamashina (1929). The North Kurile Region, so called by Kishida, corresponds to my Kamchatkan Division.

MAMMAL FAUNA OF HOKKAIDO

The distribution of mammals in Hokkaido, as defined by Prof. Aoki (1913) and Dr. Matsumoto (1918), shows that Blakiston's Line of the Tsugaru Strait marks the southern end of the distribution of Siberian animals, the so-called Hatta's Line of the Soya Strait, or the Soya Line, marks the northern end of the distribution of southern or Manchurian Subregion animals. It is also the region where animals representing the Saghalien and the Honshu types are found. Regarding this, Kishida (1925) as well as Okada and Koba (1931) seem to have reached the same conclusion. At the central part of the Tsugaru Strait a deep region of 250–300 m. is found, and in the eastern part it is even 500 m. But the Soya Strait is shallow, having a depth of less than 60 m. As a line of animal distribution, Blakiston's Line is more important, as has been proved by study of mammal distribution.

According to Kishida (1930), Hokkaido is divided, as regards the mammal distribution, into two divisions, the Lowland Region and the Highland Region. The line dividing the two regions, it is said, "should be represented by the *Pinus pumila* zone in the Daisetsu Volcano range in the central plateau, or higher zone." On Hokkaido, at altitudes lower than this zone, and on the Kuriles south of the Rasao, there is a zone called the Hokkaido Lowland Region. Here I provisionally agree with Kishida's view. Looking over the mammals in these two regions, those showing generic difference are very few. The generic difference between the North Kurile Region of Kishida (my Kamchatkan Region) and the Hokkaido Lowland Region is greater. Once I thought that a Hokkaido Division, including Hokkaido and South Kuriles, could be recognized. In this division are found the following representative forms: In the so-called Highland Division, *Sorex minutus gracillimus* Thomas, *Ursus arctos lasiotus* Gray, *Mustela erminea kanei* (Baird), *Lepus timidus ainu* Barrett-Hamilton, *Ochotona* (Kishida recognizes several "species"), *Vulpus vulpes schrencki* Kishida, *Eutamias asiaticus lineatus* (Siebold), *Clethrionomys*; and in the so-called Hokkaido Lowland Region, *Sorex shinto saevus* Thomas, *Sorex daphaenodon yesoensis* Kishida, *Sorex unguiculatus* Dobson, *Lepus timidus ainu*, *Ochotona yesoensis* Kishida, *Canis lupus hattai* Kishida, *Ursus arctos lasiotus*, *Nyctereutes procyonoides albus* Hornaday, *Martes zibellina brachyura* (Temminck), *Vulpes vulpes schrencki* Kishida, *Cervus matsumotoi* Kishida, *Eutamias asiaticus lineatus* (Siebold), *Sciurus vulgaris orientis* Thomas, *Sciuropterus russicus orii* Kuroda, and others.

MAMMAL FAUNA OF HONDO, SHIKOKU, AND KIUSIU

Hondo comprises the area from Blakiston's Line (Tsugaru Straits) in the north to the southern end of Shikoku in the south. This long and narrow area corresponds to what I have called in my distribution of birds (1925), the Tôkaidô Coast Line. Previously, Oldfield Thomas, when writing of the distribution of *Clethrionomys rufocanus smithii* (Thomas), said (1906, pp. 355–356): "It would seem to be widely spread over Southern Hondo, south of 35° N. and to be common in both Shikoku and Kiushiu, its distribution thus corresponding with that of so many Japanese animals." As relating to mammals this line I shall now call Thomas's Line. I think it can be taken as proved that although north of this line such species as *Glirulus japonicus* (Schinz), *Capricornis crispus* (Temminck), *Mustela erminea nippon* Cabrera, and others occur, they are not found in the Tôkaidô Coast division in the south (south of 35° 10′ N. lat.), a large district lying between Owari and Tsuruga. On the other hand, south of the line, *Mogera wogura kobeae* Thomas, a subspecies of large size and rich in reddish brown colors, is found in this coast district. It is the same as that found in the Kôbe district and on Shikoku. Also *Lepus brachyurus brachyurus* Temminck and Schlegel (that does not change color in winter) is found abundantly while *Lepus angustidens* Hollister (that turns white in winter or brown in both seasons) is not found on the slopes of Mt. Fuji; this is believed to be due to the fact that the area is near the Tôkaidô Coast Line or Thomas's Line. In short, Hondo is divided into three divisions by the crossing of Thomas's and Lewis's Lines. The north, I call "Honshu Central Northern Division," the next "Tôkaidô Coast Division," and the last "Chûgoku and Kiusiu Division."

There are no genera and species of mammals peculiar to the Honshu Central Northern Division, but three species are not known to occur south of 35° N. lat. They are *Canis lupus hodopylax* Temminck, *Mustela erminea nippon* Cabrera and *Mustela rixosa namiyei* Kuroda; others can be recognized as the special subspecies in the central northern part of Honshu. It is thought that *Canis lupus hodopylax* Temminck is distributed in China, but even so, it should be considered apart from the present problem. *Mustela rixosa namiyei* Kuroda is found also in Saghalien and Hokkaido, and also it is said that *Canis lupus hodopylax* Temminck occurs in Ôdaigahara, but as there is no proof, it is excluded here. Because of the above mentioned reasons, it can be recognized that although the Tôkaidô Coast Division made by the Thomas's and Lewis's lines has no endemic mammalian genera and species, it is to be regarded as a division between the southern division and the Honshu Central Northern Division.

Chûgoku and Kiusiu Division: This division includes of course Shikoku, and will be recognized as a division because it does not contain *Canis lupus hodopylax*, *Mustela erminea nippon* Cabrera, and *Mustela rixosa namiyei*

Kuroda. As to the existence or non-existence of *Ursus thibetanus japonicus* Schlegel (which is a great problem), Dr. H. Ôshima (1932) reported that there is evidence that it is found in Kiusiu also. This will be a proof that in geographical distribution, southern Honshu and Kiusiu can not be divided.

MAMMAL FAUNA OF TSUSHIMA AND SAISIUTÔ (QUELPART ISLAND)

In my opinion (1920), among the mammal fauna on Tsushima Island, those species related to species in Japan proper are comparatively numerous, and those related to species in Korea are few. As special subspecies there are the following: *Martes melampus tsuensis* (Thomas), *Urotrichus talpoides adversus* Thomas, *Apodemus geisha sagax* Thomas, *Micromys minutus aokii* Kuroda and others, and those common to Korea are *Felis euptilura microtis* Milne-Edwards, *Mustela sibirica coreana* (Domaniewski), and *Crocidura coreae* Thomas. The Chiroptera of Tsushima are not considered. Kishida also says (1925) that Tsushima is nearer to Kiusiu because of the distribution of *Mogera*, *Urotrichus*, *Apodemus speciosus*, and *Apodemus geisha sagax* Thomas, and he gives more importance to the Korean Strait than to the Tsushima Strait. Okada and Koba (1931) also argued that Tsushima is a mixed zone of elements of Japan proper and Korea. Saisiutô is very closely related to Korea, and Tsushima is a significant island in geological time since it is the transitional road of animal migration between Japan proper and Korea.

Mammals are very few on Iki Island, as on Kiusiu. On the other hand, the mammals on Saisiutô Island are entirely Korean, including, for instance, *Apodemus agrarius coreae* Thomas, *Mus bactrianus yamashinai* Kuroda, *Felis euptilura microtis* Milne-Edwards, *Cervus mantchuricus* Swinhoe and *Capreolus capreolus ochracea* Barclay, and the endemic subspecies comprising only *Mustela sibirica quelpartis* (Thomas), which is, however, the same as *Mustela sibirica coreana* (Domaniewski).

MAMMAL FAUNA OF THE KOREAN PENINSULA

Regarding the distribution of the mammal fauna in the Korean Peninsula, the land animals number 51 species and 5 subspecies, of which, according to Kishida and Mori (1931), 35 species and subspecies are peculiar to the peninsula. These distributed by orders are as follows: 4 Insectivora, 9 Rodentia, 8 Chiroptera, 12 Carnivora, and 2 Artiodactyla (some corrections are necessary). Korea has been divided by the geographical distribution of mammals into two regions, the northeastern region and the main region. I call the northeastern region the Korean Northeastern Division, animals of which belong to the Siberian Subregion and are known to be very closely related to those in Saghalien, Hokkaido Lowland, and Hokkaido Highland divisions. According to Kishida and Mori, this Korean Northeastern Division "is the area of the northeastern part of Korea or the area of the Gaiba Upland, north

of the Fusen Mountain Range of Kankyohodudo, which district is entirely included in the division." This division is the same even for the distribution of birds. Next is the Korean Main Division, belonging to the China Subregion, which includes "the entire Korean territory excepting the above mentioned Siberian Subdistrict," and comprises the main parts of Korea. Species representing the Korean Northeastern Division are, Insectivora: *Erinaceus delbatus orientalis* Allen, *Crocidura lasiura lasiura* Dobson, *C. sodyi* Kuroda, *C. yamashinai* Kuroda, *Sorex annexus* Thomas, and *Mogera robusta* Nehring. Rodentia: *Ochotona hyperborea coreana* Allen & Andrews and *Cricetulus triton nestor* Thomas (also found in main parts). Carnivora: *Felis pardus orientalis* Schlegel, *Lynx lynx cervaria* (Temminck), *Cuon alpinus* (Pallas), *Nyctereutes procyonoides ussuriensis* Matschie, ? *Vulpes kiyomasai* Kishida & Mori, *Vulpes vulpes peculiosa* Kishida (also found in main parts), *Mustela nivalis mosanensis* Mori, *Mustela sibirica manchurica* Brass, and *Martes zibellina hamgyenensis* Kishida. Artiodactyla: *Cervus hortulorum hortulorum* Swinhoe, *C. canadensis xanthopygus* Milne-Edwards, *Capreolus pygargus pygargus* (Pallas), *Moschus moschiferus parvipes* Hollister, and *Naemorhedus raddeanus* (Heude).

Next, in the Korean Main Division are, Insectivora: *Erinaceus amurensis koreensis* Mori, *Crocidura coreae* Thomas, *C. lasiura thomasi* Sowerby, and *Mogera wogura coreana* Thomas. Rodentia: *Lepus coreanus* Thomas, *Microtus kishidai* Mori, *Cricetulus triton nestor* Thomas, *Apodemus agrarius coreae* Thomas, *Apodemus speciosus peninsulae* (Thomas), *Mus bactrianus yamashinai* Kuroda, *Petaurista leucogenys hintoni* Mori, and *Sciuropterus russicus aluco* Thomas. Carnivora: *Felis euptilura microtis* Milne-Edwards, *Canis lupus laniger* (Hodgson), *Nyctereutes procyonoides koreensis* Mori, *Vulpes vulpes peculiosa* Kishida, *Martes melampus coreensis* Kuroda & Mori, and *Charronia flavigula koreana* Mori. Artiodactyla: *Sus leucomystax coreanus* Heude, *Cervus nippon mantchuricus* Swinhoe, *Capreolus capreolus ochracea* Barclay, and *Hydropotes inermis argyropus* Hollister. In short the genera necessary for mammal distribution problems in Korea are *Ochotona*, *Cricetulus*, *Cuon*, *Charronia*, *Hydropotes*, *Moschus*, *Naemorhedus* and others. The opinion that Korea is an extension of the Manchurian Subregion is correct.

MAMMAL FAUNA OF THE RIU KIU CHAIN

Wallace (1876) drew the line dividing the Palaearctic and Oriental Regions from the neighborhood of Ningpo, China, to the Riu Kiu Islands, and included the Sakishima Islands and Formosa in the Indo-Chinese Subregion, but did not mention the animals of this chain. The scientist who first proposed that this dividing line must be between the islands near the south coast of Kiusiu and Amami-Ôshima Island was D. Brauns (1884), as was stated by Okada and Koba (1931). W. L. Sclater (1899) showed that the eastern

limit line of the Burmo-Chinese Subregion is in the Sakishima Islands, but he did not mention the animals of the Riu Kiu. Prof. Aoki (1913) said that the dividing line of the two regions, Palaearctic and Oriental, is between the Yakushima and Amami-Ôshima. Although I did not publish the fact, I announced at the meeting of the Zoological Society of Japan held on April 26, 1924, that Watase's Line of Shichitô-nada is the boundary line of the Palaearctic and Oriental regions, the same as in the case of bird distribution. Kishida (1925) reached the same conclusion from the standpoint of mammals. That the important line dividing the Palaearctic and Oriental regions in the animal distribution is this Watase's Line (also called Aoki's Line) is undisputed. (But, concerning invertebrates, there are some scientists who disagree.)

SOUND REASONS FOR WATASE'S LINE

I published the reasons from the standpoint of the distribution of vertebrates (1931b), and here will be mentioned the part concerning mammals.

Among the genera distributed from southern Kiusiu to Yakushima there are *Mogera*, *Apodemus*, *Mustela*, *Cervus* (Kerama deer is not considered as having been brought from Satsuma), and *Macaca*, or five well known genera, but south of Amami-Ôshima they are not found (excepting in Formosa) and in their place are found *Pentalagus*, an Oriental genus endemic to Amami-Ôshima and Tokunoshima, and *Diplothrix* (peculiar to Amami-Ôshima, Tokunoshima and Okinawa main island). *Pentalagus furnesi* (Stone) and *Diplothrix legata* (Thomas) are not only peculiar to Amami-Ôshima and vicinity, but are rare species. *Pentalagus furnesi* (Stone) is preserved as a Natural Monument and its killing is prohibited under the Game Law. The subspecies *Rattus jerdoni osimensis* Abe strangely is found in Amami-Ôshima, and is a representative Oriental species. By the above the authenticity of Watase's Line is increased. Among those species especially found in the south of Amami-Ôshima are *Crocidura watasei* Kuroda (Amami-Ôshima and probably Okinawa Island), *Pteropus dasymallus inopinatus* Kuroda, (Okinawa Island), *Pteropus d. daitoensis* Kuroda (Daito Islands), *P. d. yayeyamae* Kuroda, *Pteropus mariannus loochoensis* Gray (Okinawa Island), *Hipposideros turpis* Bangs (Ishigaki, Iriomote and Yonakuni islands), *Sus leucomystax riukiuanus* Kuroda (Amami-Ôshima, Okinawa, Ishigaki, and Iriomote islands) and others. The bird distribution on Yonakuni Island, at the southern end of the Riu Kiu Chain, shows a strong tendency of belonging to Formosa, but of mammals only *Pteropus d. yayeyamae* Kuroda, *Hipposideros turpis* Bangs and *Mus molossinus yonakuni* Kuroda are known. *Hipposideros turpis* Bangs is represented by another species in Formosa. Therefore Kishida proposed three divisions for Amami (Amami and Tokunoshima), Okinawa (Okinawa, Kerama, and Kume islands), and Saki-Shima (Ishigaki, Miyako and Iriomote), and included them in the Oriental Region.

He considered that they were related to Formosa, and that the territory from Amami to Saki-Shima is the transition tract between the Palaearctic and Oriental regions. I agree with his view but I wish to join Okinawa to Amami.

MAMMAL FAUNA OF FORMOSA

Wallace (1876) said that the animals of Formosa are those of the Chinese or Himalayan system, when the endemic species are excluded. Kishida (1925) placed the island in the Burmo-Chinese Subregion, with strong elements of the Indian Subregion and without any element of the Philippine Islands. Aoki (1930) discussed 62 species of land mammals. He asserted that they are representatives of the Oriental Division of the Indo-Chinese system, and declared that some without change and others with some changes appeared in Formosa. Even the species of true rats which are so widely distributed, he said, have no relation with those of the Philippine Islands. I believe the opinions of the two scientists are correct. Horikawa (1925) divided Formosa according to the animal distribution into three sections, north, south (including Niitakayama and Arisan) and east.

Mammals of Formosa especially to be mentioned are *Lepus sinensis formosus* Thomas, *Microtus kikuchii* Kuroda, *Eothenomys melanogaster kanoi* Tokuda, *Apodemus semotus* Thomas, *Rattus coxinga* (Swinhoe), *R. culturatus* Thomas, *Mus formosanus* Kuroda, *Callosciurus erythraeus thaiwanensis* Bonhote, *Dremomys owstoni* (Thomas), *Petaurista grandis* (Swinhoe), *P. lena* Thomas, *P. pectoralis* (Swinhoe), *Belomys pearsoni kaleensis* (Swinhoe); *Ursus thibetanus formosanus* Swinhoe, *Helictis subaurantiaca subaurantiaca* Swinhoe, *Mustela sibirica taivana* Thomas, *Charronia flavigula xanthospila* (Swinhoe) *Sus leucomystax taivanus* (Swinhoe), *Cervus unicolor swinhoii* (P. L. Sclater), *C. taiouanus* Blyth, *Muntiacus reevesii micrurus* (P. L. Sclater), and *Capricornis swinhoii* Gray. Of those mentioned above *Microtus kikuchii* Kuroda, *Rattus culturatus* Thomas, *Dremomys owstoni* (Thomas), *Mustela sibirica taivana* Thomas and others are peculiar forms known as mountain animals. Besides those of the Indo-Chinese system, there are *Macaca cyclopis* (Swinhoe) (also in Hainan Island), *Felis viverrina* Bennett, *Felis diardi* Desmoulin, *Felis bengalensis chinesis* Gray, *Paguma larvata taivana* Swinhoe, *Viverricula indica pallida* (Gray), *Manis pentadactyla pentadactyla* Linnaeus, and others.

MAMMAL FAUNA OF BOTEL TOBAGO

As an animal peculiar to this island there is one described in 1936 under the name of *Crocidura tadae* Tokuda & Kano, and besides that there are three species occurring also in Formosa, *Hipposideros armiger terrasensis* Kishida, *Paguma larvata taivana* Swinhoe, and *Pteropus dasymallus formosus* Sclater. On the other hand there is a species, *Rattus mindanensis* Mearns, in common

with the Philippines. With only these materials, there is no other alternative but to declare that Botel Tobago is included in the Indo-Chinese Subregion, the same as Formosa. But in the case of avifauna and insect fauna, there are found two or three elements of the Philippine Subregion, and it is believed proper to regard it as in the Indo-Malayan Subregion. In short there is no doubt that the faunas of the two subregions are found there. In the Kashitô Island is found *Pteropus dasymallus formosus* Sclater, which also occurs in Formosa (caught at Karêen near Karenkô and Shinkô) and Botel Tobago (caught once). From the avifauna of this island I would regard it the same as Botel Tobago. Because of the above mentioned reasons, on the basis of the bird distribution in Japan, I have extended the north end of Wallace's Line, modified by E. D. Merrill, to between Botel Tobago and the Formosa Main Island. I believe that this line will also serve probably in separating Kashotô Island from Formosa Main Island.

MAMMAL FAUNA OF THE BONIN ISLANDS

The only species peculiar to the Bonin Islands is *Pteropus pselaphon* Say; *Mus caroli boninensis* Kuroda is only a subspecies and *Cervus unicolor boninensis* Lydekker does not deserve any attention in geographical distribution, as it is an introduced subspecies. *Pteropus pselaphon* Lay has five allied species in the Polynesian Subregion of the Australian Region, and also one allied species in the Indo-Malayan Subregion of the Oriental Region. Because of these reasons, the mammals of the Bonin Islands (probably also of the Volcano Islands) should be considered as between the Polynesian Subregion and the Indo-Malayan Subregion. It even may be said that the islands are nearer to the Polynesian Subregion.

MAMMAL FAUNA OF MICRONESIA UNDER JAPANESE MANDATORY RULE

The mammals in the South Sea Islands under our rule comprise only bats, rats, and mice, and their special species all belong to the Polynesian Subregion. Bats are distributed as follows: *Pteropus mariannus yapensis* Andersen (Yap Island), *P. mariannus mariannus* Desmarest (Guam, Rota and Saipan islands in the Mariannes), *P. mariannus paganensis* Yamashina (Pagan Island in the Mariannes), *P. mariannus uluthiensis* Yamashina (Uluthi Island in the Carolines), *P. mariannus ualanus* Peters (East Carolines), *P. mariannus pelewensis* Andersen (Palau or Pelew Islands), *P. molossinus* Temminck (Mortlock and Ponape islands in the Carolines), *P. insularis* Hombron & Jacquinot (central Carolines), *P. phaeocephalus* Thomas (Mortlock Island in the Carolines), *P. pilosus* Andersen (Pelew Islands), *P. tuberculatus* Peters (not certainly known, but probably Vanikoro or Guam of the Mariannes). The above are fruit-eating bats or Megachiroptera. *Emballonura semicaudata palauensis* Yamashina (Pelew Islands) and *E. semicaudata sulcata* G. S. Miller (Truk Island) are insect-eating bats or Microchiroptera. Of rats

there are *Rattus rattus alexandrinus* (Geoffroy) (Mariannes, Marshalls and Truk islands), and *R. norvegicus norvegicus* (Erxleben) (Saipan, Ponape and Koror Islands). Both have been introduced.

There are in addition to the above *R. exulans* Peale (Yap, and Marshall islands) and *R. exulans micronesiensis* Tokuda (Pelew, Yap, and Ponape islands). *Mus musculus momiyamai* Kuroda is found on Yap and Ponape in the Carolines and Yaluit Island in the Marshalls; it is also found sparingly on Saipan Island, but it is believed to have been brought by ships. *Mus caroli boninensis* Kuroda is found abundantly on Saipan Island. Thus the opinion that it was brought into the Bonin Islands from the south is correct.

The above is the outline of the mammal distribution in Japan, and it is shown in the following diagram:

- Caenogaea—Palaeartic Region
  - Siberian Subregion
    - Kamtschatkan Division (North Kuriles)
    - Korean North-eastern Division (Kankyôhokudô and northern parts of Kankyônandô
    - Hokkaido Highland Division (Daisetsu Volcano range)
  - Chino-Manchurian Subregion
    - Hokkaido Lowland Division (South Kuriles and Hokkaido lowlands)
    - Honshu Central North Division (north of 35° 10′ North Lat.)
    - Tôkai Coast Division (south of 35° 10′ North Lat.)
    - Chugoku & Kiusiu Division (Shikoku, Iki, Tsushima, Yakushima)
    - Korean Main Division (Entire peninsula excepting north-eastern parts; and Saisiutô)
- Mesogaea—Oriental—Indo-Chinese Region Subregion
  - Amami Division (Amami-Ôshima to Okinawa)
  - Sakishima Division (Yayeyama Islands)
  - Formosan Division (Botel Tobago?)
- Palaeogaea—Australian Region—Polynesian Subregion (Japanese Mandatory South Sea Islands to the Bonin Islands?)

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THE IDENTITY OF CAPTAIN COOK'S KANGAROO

BY H. C. RAVEN

In July, 1770 (Hawkesworth, 1773, III), while Captain Cook's ship was being repaired at a place on the northeastern coast of New South Wales, now known as Cooktown, Queensland (Queensland having been separated from New South Wales in 1859), his party secured two kangaroos, one weighing 38 pounds and the other 84 pounds. The latter was said to be not quite adult. He may have secured more than these two specimens, for he reported (August 4, 1770, p. 591): "There does not indeed seem to be many of any animal, except the kanguroo; we scarcely saw any other above once, but this we met with almost every time we went into the woods."

Following the publicacion of Hawkesworth's report (1773) of Cook's voyage round the world, several zoologists copied his description and figure of the kangaroo and gave it a binomial technical designation that conformed to the Linnaean taxonomic procedure of the time.

Later, kangaroos of several species were discovered, described and named from other parts of Australia, and from time to time revisions of the group were made.

In 1846, volume 1 (Marsupiata) of G. R. Waterhouse's 'Natural History of the Mammalia' was published. This contained the most extensive revision of the kangaroos up to that time, and the author referred to Cook's specimens as the great kangaroo, *Macropus giganteus*. Waterhouse wrote (p. 63): "The earliest technical name applied to the animal was that of *Yerbua gigantea*, given by Zimmerman in 1777 . . ." [see this paper, p. 56].

A still more extensive and thorough revision of the kangaroos was that of Oldfield Thomas (1888), who reviewed very carefully the literature relative to Cook's kangaroo and gave an extensive synonymy and bibliography of this animal, which he too called *Macropus giganteus*, and unmistakably referred to Cook's kangaroo as the type of the species. He wrote: "Type, not in existence." Further, he stated (p. 10) that *giganteus* is the type species of the genus *Macropus* Shaw.

Following Thomas's classical treatise of 1888, all the better known general works on mammals, such as Flower and Lydekker (1891), Weber (1904,1928), and innumerable technical papers, use *Macropus giganteus* for the great gray kangaroo. This also is true of works on Australian mammals by such well known Australian naturalists as Lucas and D. Le Souef (1909), Wood Jones (1924), and A. S. Le Souef, Burrell, and Troughton (1926). It is thus evident that by usage, *Macropus giganteus*, the great gray kangaroo and Captain Cook's kangaroo are one and the same animal.

Iredale and Troughton (1925) quoted various passages from Cook's account of the discovery of the kangaroo and printed in Latin a copy of Dr. Solander's manuscript description of the kangaroo, which they received from the library of the British Museum. Dr. Solander was a naturalist on Cook's voyage and the authors assumed that Cook took his description from that of Solander, which was more detailed. After examining this Latin description, Iredale and Troughton concluded that Solander's description was not applicable to the kangaroo now known as the great gray kangaroo, *Macropus giganteus*. They wrote (p. 316): "Realising that the diagnostic characters of Cook's Kangaroo may be applicable to several forms of *Macropus*, we have refrained from a drastic interference with nomenclature, so that the present arrangement may stand, pending added proof of our conclusion that the Cooktown animal was not the Great Grey, but a smaller form, probably of the *robustus* series."

Recently, Iredale and Troughton (1937) have published another paper on the identity of Cook's kangaroo. Since their first paper (1925) two specimens of a kangaroo were purchased for them in the Cooktown area, one a wallaroo. This they described as "a richly coloured animal of the *antilopinus* type and therefore in no way comparable with the 'mouse' and 'ash' coloured animal of the Cook accounts." They then went on to say: "Troughton recently reviewed the characteristics of the whiptail in regard to the specimen from Cooktown and found them in general agreement with the original accounts, excepting that the incisors were not in accordance with our first interpretation of Solander's description. Further analysis of the debatable passage, however, makes it clear that the phrase which apparently referred only to the structure of the third incisor actually constitutes a comparative reference to the combined anterior ones, in the light of which interpretation the description of the incisors proves to be quite typical within the known variation of these teeth in the whiptail wallaby".

With reference to the passage above, Dr. W. K. Gregory, who kindly translated it for me from the Latin as given by Iredale and Troughton, says that their translation is a forced interpretation. The plain meaning of the phrase "*tertium latius crassiusque, bilobum: lobis anticis minoribus*" is "third broader thicker, bilobed: with anterior lobes smaller". Thus it cannot be applied to the condition found in the third incisor of the whiptail but does agree with the structure of this tooth in the great gray kangaroo.

I now quote another paragraph from Iredale and Troughton (1937, page 68): "In addition to the incisors, other salient points of agreement between the first accounts and the whiptail are the slender form and long tapering tail, which equals the body length, long ears, and especially the rhinarium, which is entirely hairless and black, with a mosaic scale pattern."

Comment has already been made on the incisors. The slender form is characteristic of the great gray kangaroo. Thomas (1888), at the beginning of his description of this animal, said: "form comparatively slender and graceful". Next, as to the "long tapering tail, which equals the body length", Cook wrote (p. 578): "The tail is nearly as long as the body, thick near the rump, and tapering towards the end". This agrees with Solander's manuscript and with specimens of the great gray kangaroo.

Iredale and Troughton said that Cook's kangaroo agrees with the whiptail in its "long ears", but the Solander manuscript reads: "Ears ovate-oblong, obtuse, erect, bases crowded together, simple, hairy, rather short ($\frac{1}{3}$ head)". In this character, too, the original description agrees with the great gray kangaroo and wallaroo but not with the whiptail. Further, they said that the whiptail agrees with Cook's kangaroo in "especially the rhinarium, which is entirely hairless and black, with a mosaic scale pattern". On this point the Solander manuscript (translated) says: "Rostrum rather short, equally compressed with tip bare between the nostrils and with the skin covered with very black fine wrinkles." This condition is more obvious in the wallaroo and whiptail; but black, finely wrinkled skin does surround each nostril of the great gray kangaroo.

The next character is that of color. Iredale and Troughton wrote: "The general colouration of the Cooktown skin [a whiptail], which is less contrasted than in typical southern examples, agrees also with the original accounts, which variously note 'mouse colour,' 'dark mouse or grey colour,' 'ash coloured,' and 'cinereus' in Solander's description, for the general colour. Allowance must of course be made for individual and seasonal variation, such as shown in a series of southern examples . . ."

Solander's manuscript says more than just "cinereus"; a full translation would be "Color of the whole animal ashy, with darker ears". I have compared a good series of skins of North Queensland whiptails, taken about 130 miles south of Cooktown, with others from Southern Queensland and New South Wales, nearly 1000 miles away, and I find very little variation in color. This leads me to quote H. H. Finlayson (1931, p. 77), who remarked concerning the whiptail: "As regards pelage, *parryi* appears to be a very uniform species all over its range; sexual, season, and individual variations all being quite insignificant. Midwinter skins (August), when compared with those taken in January, show a slight increase in density on the ventral surface, but the dorsal coat remains short and rather thin and the colouration is precisely the same". Whereas the general coloration of the great gray

kangaroo could, as its name indicates, be called "cinereus", "mouse coloured" or "dark mouse or grey coloured", the whiptail could not, for its coloration is decidedly variegated, with an area of pure white on the belly and, as Thomas said (p. 39), "sides of rump white".

The most striking coloration of the whiptail, however, is on its head, and it is inconceivable that the draughtsman Parkinson, who was with Captain Cook and who doubtless made the original of the figure reproduced by Cook, would overlook those characteristic markings if he had been depicting a whiptail. Nearly all authors emphasize the characteristic markings of the whiptail's head. Thomas (p. 39) said of this species: "Face-markings distinct and well defined". Finlayson (p. 76) said: "The head, in addition to its striking markings . . ." These markings are so well defined that they show clearly in photographs. On the other hand, photographs of the great gray kangaroo resemble closely the figure in Cook's account. This figure does not resemble a wallaroo, which has heavier fore quarters and a rougher coat.

I trust that the evidence given herein will deter naturalists from the drastic and unwarranted changes in the nomenclature suggested by Iredale and Troughton.

Iredale and Troughton concluded their paper by stating that the name of the great gray kangaroo should be changed to *Macropus major*, whereas it has borne the name *giganteus* for 160 years. They decided, on the basis of the skull and the flat, perhaps faded skin, lacking the paws, of a whiptail taken 12 miles from Cooktown, that Cook's kangaroo was a whiptail and they call it *Wallabia cangaru* Müller, 1776, with the following synonyms: *Mus cangaru* Müller, 1776 (Müller is misquoted; he used the spelling *canguru*, not *cangaru* (Syst. Nat., suppl., p. 62)); *Jaculus giganteus* Erxleben, 1777; *Jerboa gigantea* Zimmermann, 1777; *Didelphys gigantea* Schreber, 1777; *Zerbua kangaru* J. R. Forster, 1778; *Didelphis kanguru* Zimmermann, 1780; *Mus caenguru* Hoslin, 1781.

Because they have failed to find the great gray kangaroo at or near Cooktown now, they assume that it did not occur there in the past. There are several specimens of it in the American Museum of Natural History and the United States National Museum from the Atherton tableland, 130 miles to the south of Cooktown, and W. H. Dudley Le Souef in his book on 'Wild Life in Australia' (p. 367), recorded 5 gray kangaroos and two pretty-face, or whip-tailed kangaroos seen between the Bloomfield River and Cooktown (in 1897). As the Bloomfield River is only 30 miles from Cooktown it is quite likely that the gray kangaroo, if not now inhabiting the neighborhood of Cooktown, has only recently been extirpated and may well have been abundant before the country was settled by whites.

Besides changing the name of the great gray kangaroo to *Macropus major* and the whiptail of the Cooktown and Cape York peninsulas to *Wallabia cangaru*, Iredale and Troughton also changed the name of the southern whip-

FIG. 1

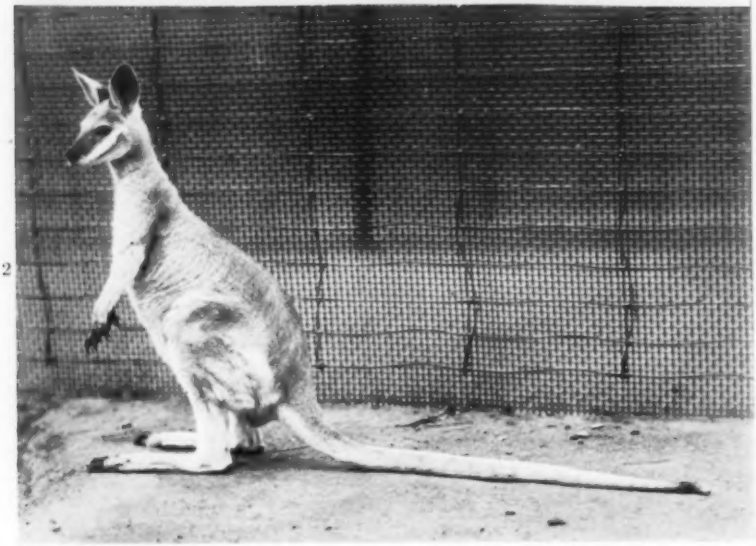

FIG. 2

FIG. 1. Captain Cook's kangaroo. From a photograph of the original figure published in 1773.

FIG. 2. The whiptail or pretty-face wallaby, showing the longer tail and striking facial markings; the backs of the ears are dark at the base and light at the tips. Courtesy New York Zool. Soc.

tail to *elegans*. Thomas rejected the name *elegans*, with the following bracketed footnote: "*Macropus elegans*, Lambert, Linn. Trans. VIII, p. 381, pl. xvi (animal) (1805). It is impossible to decide with certainty to which species this description belongs. Gray considered it to be the present species [*Macropus ruficollis*] while Waterhouse assigned it to *M. parryi*; but the

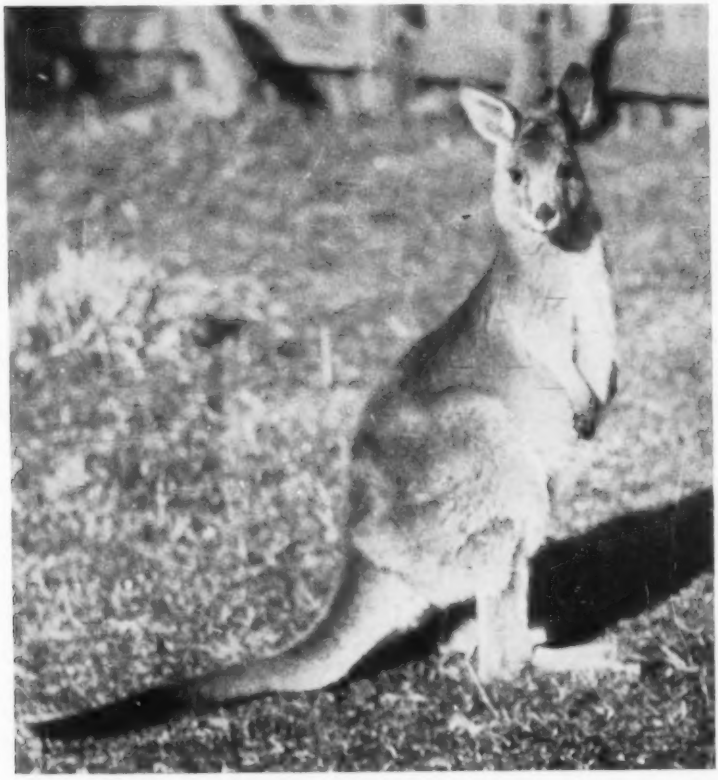

FIG. 3. The great gray kangaroo, showing the more uniform coloration of the body and head, and the light-colored hair bordering the inner side of the ear.

figure shows no trace of the latter's prominent face-markings, which could hardly be overlooked by the most careless artist. In fact the description might be applied either to small specimens of *M. giganteus* (e.g., var. *melanops*) or of *M. robustus*, or to large ones of *M. parryi* or of *M. ruficollis*. The name must therefore be ignored as of uncertain application".

Aside from Lambert's figure of *M. elegans*, which shows no distinctive markings, his description of the animal's habits indicates, in the light of our present knowledge of the habits of the whiptail, that it was not that species, for Lambert wrote of *M. elegans* (p. 318): "Dr. White, who so long resided in New South Wales, informs me that this species is very scarce, and that its habits are very different from those of the common kangaroo, it being always found solitary, whereas the other is found in herds of forty or fifty together".

Finlayson (1931, p. 75), in writing of the whiptail, said: "It is distinctly social in habit, and very likely truly gregarious, though it would take closer and more prolonged observation than I was able to give to determine the point. It certainly camps in rather large parties, 12–15 being frequently seen lying up together . . ."

Iredale and Troughton have called attention to the description of Cook's kangaroo by Müller (1776), in which the animal was named *Mus canguru*. As this name antedates, so far as is known, all other technical names applied to the animal discovered by Cook, it is clear that according to the International Code of Nomenclature this name should take the place of *giganteus*. Only by a ruling of the International Commission can it be laid aside in favor of the better known name *giganteus* (see report Ninth Internat. Zool. Congr., Monaco, 1913, p. 890; Proc. Biol. Soc. Washington, vol. 39, p. 88, July 30, 1926).

I trust that the evidence given here is sufficient to establish the following points:

(1) The evidence is decidedly against the assumption that Cook's kangaroo was the whiptail or pretty-face wallaby, commonly known by the specific name *parryi*.

(2) Thomas was right in discarding the name *elegans* Lambert 1807, because it is impossible to decide with certainty to which species Lambert's description applies.

(3) Captain Cook's kangaroo was rightly identified by the early revisers of the Macropodidae as being specifically the same as the great gray kangaroo of Queensland and New South Wales, which for 160 years has borne the name *giganteus*; and this species was still to be found within a few miles of Cooktown at the close of the last century.

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NOTES ON A PAIR OF TARSIERS FROM MINDANAO

BY GEORGE CHASE LEWIS

Two specimens of *Tarsius carbonarius* Heude, taken at Parang-Parang, Mindanao, Philippine Islands, April 1, 1917, and now nos. 218238 and 218239, U. S. National Museum, were kept in captivity for 8 days. They appeared slow and sluggish, but this was very deceptive, for they could move with such speed as almost to defy the eye to follow. They progressed over the floor by long hops like a frog. They would dart at an insect and seize it with their enormous hands, pinning down the insect and biting it. They never used their hands to lift the prey to the mouth, but would use them to hold the insect in their mouth after having seized it with their jaws. They were highly nocturnal, but would eat in daylight, though then having difficulty in locating their prey. At night, they would leap with unerring accuracy on insects. The distances covered in these leaps were startling for so small an animal, much greater in proportion than those of a bull frog of the same size. They stuck without difficulty wherever they alighted at the end of this bird-like flight, on a chair leg, table leg, or wall. The tail has no grasping power but is clearly of much use in balancing and steering in their long leaps. Leaps of 4 feet to 8 feet on the level floor were made without apparent effort, followed by second or third leaps the instant of alighting so that the impression on the observer was that of an almost continuous flight. One care-

fully measured leap from the floor level to the projecting corner of the room, where the male tarsier clung to the wall, was 6 feet, 4 inches, horizontally, and the point of lodgement was 3 feet, 7 inches, above the floor. This projecting corner was a favorite lodging place, and leaps made from it at above the height of a man's head would land the animals on the floor at from 12 to 15 feet distance. The tarsiers could not retain their position on a flat vertical wooden wall unless there was a corner or angle, which enabled them to get a certain amount of lateral pressure. There was, however, enough adhesiveness in the finger pads to enable them to take off immediately for a second leap from such a vertical surface and to rise above the point of take-off. I have several times seen the male tarsier zig-zag in short successive leaps from wall to wall in a corner of the room, until he reached the ceiling or gained enough altitude to take a wide 12 or 15 foot jump to the floor or to a piece of furniture. My "Sala" at Parang-Parang was a large L-shaped room with 6 corners, of which one was a right angle re-entrant. Both tarsiers were able to find fine lodgement on this re-entrant angle, by bringing a left hand and foot on one side of the angle and the right hand and foot on the other. Thus supported they would stay for as much as half a minute in seeming security. This position was always taken with the head up. I tried several times to see if they could lodge on this angle in the head-down position, but they never succeeded in taking lodgement either with or without my assistance. I am doubtful whether there was actual inability to lodge in the head-down position or whether they were distracted because of handling. At present I recall only once seeing them lodge in a head-down position on a large table leg, very much like a squirrel coming down a tree. So far as I know the digital suction discs are a unique organ among mammals though relatively common among some reptiles like the geckos. I tried several times to get the tarsiers to lodge on the surface of a mirror, which was the only large glass surface in my bungalow. The distracting influence of a strange tarsier and probable enemy in the mirror prevented any fair test of their holding ability on glass. Both were too apprehensive of the threatening teeth displayed by their own reflections to make any attempt to adhere.

One of the animals had a very high-pitched bat-like squeak, around 10,000 vibrations per second and up to the limit of my hearing. It was quite tame and would sit in my hand and permit itself to be stroked, but would launch out on one of its long leaps without warning. It would take live insects from the fingers, and sometimes nip the fingers in its eagerness. The male several times snapped at my fingers in momentary petty spite, while resting in my hands. He had a trait of morose irritability during daylight and on two occasions he slowly and deliberately turned his head and seized my thumb in his sharp little teeth, inflicting painful bites. He was not prone to bite at night, when on the alert, once he had been taken into the hands and the first defensive reaction to human handling had been pacified. The natives

referred to them as "night rats" (daga na gabii) and were superstitiously fearful of them because of their extraordinary eyes. Our cook made protective charm motions with his fingers whenever he saw one of these harmless little animals fix its huge gargoyle eyes on him. My wife and I several times took the tarsiers into our kitchen to catch cockroaches at night. They would detect a roach almost instantly and a flying leap rarely missed capture of the desired dainty. Unfortunately, for some freak reason, our kitchen was very short that week of the usual swarming crop of tropical roaches. Recourse was therefore made to visits to neighboring officer's kitchens, but without much better success. Native boys, however, supplied a fair stock of live grasshoppers and locusts for the nightly feeding. I suspect that there were some special varieties of forest insects that these highly specialized animals required for their welfare which we could not supply and the lack of which led to their untimely and regretted deaths at about the time they were becoming accustomed to human friends.

The female was very gentle. Both would have made excellent pets if their special diet requirements could have been met. They ate only grasshoppers and roaches, refused raw and cooked eggs or meat, rice, grains, and fruits. They spent the daylight hours huddled up in each others arms, but with eyes only partly closed and pupils contracted to pin points. When first approached they would sit back on their haunches, jaws wide open and threatening, and both enormous hands wide spread in front like a wrestler. As soon as taken into the hands they would cuddle down and become quite gentle and fearless. The teeth were very sharp and needle-like and never failed to draw blood, though the jaws were very weak. The native Moros told me that the tarsier specially favored areas where the large trees had been killed through burning of their bark by forest fires, leaving the bare trunks standing for years afterwards like telegraph poles. They stated that it was impossible to catch them at night, though they could be seen readily on star-light or moon-light nights. The only way to catch them was to locate a hollow tree or crevice and smoke or cut them out in daylight, when the animal was nearly blinded. Most Moros consider the tarsier an unclean animal, so that they will not hunt it. To this superstition is largely due the survival of the species in the Moro territory. The transition of the animal from its owl like attitude of helplessness in daylight to its vigorous and alert nocturnal activity is most surprising when first seen.

DESCRIPTION OF THE ANIMALS

Male, length 275 mm., tail 246, foot 66; female, 269, 242, 66; with 6 mammae. Iris seal brown, pupil round. Hair very soft, furry and curly, 18 to 20 mm. long between shoulders on the back; on sides shorter, 12 to 15 mm. on outer thighs, 10 to 12 mm. on lower leg; tarsus bare. Inner edge of thigh scantily furred, almost bare, the hairs noticeably shorter than on outer sur-

face. Hair on breast very heavy, about 12 to 15 mm., on abdomen shorter but well developed. Upper arm same as shoulders; forearms very densely covered with hair 5 to 6 mm. long. Tail scantily covered, rat-like throughout its length, with short stiff brown hairs 1 mm. long; a tuft of well defined hairs 4 to 6 mm. long for the last $\frac{3}{4}$ inch of the tip. Base of tail for $\frac{3}{4}$ of an inch covered with hairs similar to those on the body. All body hairs with brown reddish tips and mouse blue bases, the bluish strongly predominating whenever the hair was ruffled or wet. Brown tips distinctly darker on top of head and neck, and much lighter and more yellowish on abdomen. Ears bare on inner surface and almost bare on upper surface; they are thin, transparent, erectile in life, resembling bats ears, 26 mm. long x 21 mm. wide. Eyes enormous. Iris highly motil, contracting and expanding from pin point in day time to 13 mm. at night. Face like a gargoyle with its enormous eyes. Hind legs much larger and longer than forelegs, giving a curiously frog-like effect to the animal's movements. Hind leg from crotch to tip of longest toe, 164 mm.; foreleg from longest finger to arm pit, 86 mm. Teeth all modified for insectivorous diet.

SPECIAL STRUCTURE OF THE HIND FOOT

The great toe or thumb is about twice as thick as the next heaviest toe, opposable, the nail rudimentary and almost invisible. It terminates in an enormous pad or flattening, similar to that of a tree frog, but with no special secretion on the inner surface. The inner surface is usually moist, but not gummy or sticky. I believe a sucker-like action is obtained with those finger pads by muscular action. This could be distinctly felt when the animal clung to the finger of one's hand. The animal could not adhere to the flat surface of a pane of glass, but would adhere to the corner of a polished piece of furniture, as a bureau or desk, where it could get a hand and foot on each side of a vertical corner and secure a certain amount of pressure. No monkey or rat could possibly remain or sustain itself in such a position; and the ability must be due to some property in these large toe and finger pads. In addition to the terminal pads there is a large pad at the base of the great toe, one pad at the base of the first and second fingers on the palm, and one pad extending from the base of the third and little fingers along the length of the outer edge of the sole of the foot. The two toes nearest the thumb are much shorter than the fourth digit. The lengths of the hind toes were as follows: Thumb 18 mm.; 2nd digit 9; 3rd digit 19; 4th digit 23; 5th digit 18. The first and second toes have well formed nails, sharp, triangular, 4 mm. long, which stand up at right angles from the terminal toe pads and can not be lowered. The 4th and 5th digits have flat nails like men or monkeys, covering about one third of the area of the toe pad.

SPECIAL STRUCTURE OF THE FOREFOOT

The hand is very large in proportion to the size of the animal, with extraordinarily long fingers, no web between fingers, thumb slightly opposable, all digits terminated by round pads about twice as wide as the finger, free from secretions or gummy stuff, moist, and showing evidence of muscular cupping action forming suction disks on under surface. It was very difficult to get any clear observation of how these finger pads are really used but several times in slowly loosing the animal's grasp from a polished surface, I noticed a distinct cup- or crater-like effect on the surface of these finger pads. This was not always seen, and was never seen on a rough or moist surface as when the animal was clinging to the finger of my hand; but such sucking action on the large palmar pads was clearly felt when the animal clung to my bare arm, which was too large for the animal to grasp as it did the human finger.

EYES

Interesting as are the special developments for nocturnal insect hunting represented by the row of needle-like teeth, huge hands like base ball catchers mits and the extraordinary powers of leaping and lodging on a vertical surface, the feature which most readily caught and held the observer's attention was the huge eyes. In comparison with the eyes, the rest of the features of the face during life lapsed into insignificance. The relative size of the eyes to the rest of the face is even greater in *Tarsius* than in the owls, and the eye sockets extend laterally beyond the normal face contours like great aviation goggles. The limits of pupillary expansion are extraordinary, ranging from a pinpoint in daylight to 13 mm. by lamp light by actual measurement. I estimate the pupil to be about 16 to 18 mm. in width in star light. It was not possible to accurately measure the pupillary width by faint light as the approach of any artificial light to the highly sensitive mechanism promptly produced pupillary contraction. The eyes possessed great mobility and rolled widely sidewise and vertically in their sockets, exposing great expanses of white eye ball in the faint light in a way reminiscent of a southern pickaninny hearing a ghost story. A more weird and ghostly countenance than that of the tarsier could not be found outside of a witches family album. It is no wonder that primitive people attribute mystic powers to this strange animal.

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EFFECTS OF A WET YEAR ON MAMMALIAN POPULATIONS

By Joseph Grinnell

The past winter was an unusually wet one in some parts of California, though not in others. Certain local records show that total precipitation was greater than in any year since 1921, and that for periods of a few hours the downpour was heavy beyond any previous record. What effects might such extreme climatic condition show upon numbers of mammals of one kind or another?

For a few days, in the latter part of June, 1937, Mrs. Grinnell and I drove about over the northeastern section of California. Results of recent flood conditions were apparent all along, from and including the Feather River district in Plumas County north to the Oregon line and from the Nevada line in Surprise Valley west to about the eastern Siskiyou County boundary. Gross washing and gullying had occurred wherever the natural land surface had been cut or modified by human agency; stream beds had carried huge volumes of water as shown by high position of drift masses; and, more to the point of these remarks, large areas of flat land were still under sheets of water, with indications of far more extensive inundation previously. On the Madeline Plain, for example, the water, although now largely gone, had stood for so long that large tracts of long-lived shrubby plants, notably a species of *Chrysothamnus*, had been killed by drowning. From a point on the highway across the flats near the marginal railroad station of Madeline, we looked up to the old beach lines on the semicircling hillsides and thought how an increase in the present annual rainfall, not so great in amount, would fill the basin, to overflow into the great Lahontan Basin—bringing heydays again for muskrat and beaver.

The three Alkali Lakes, in Surprise Valley, were seas showing whitecaps in the brisk south wind, the water at their margins lapping into the brushland—not a bit of playa was left exposed. Cowhead Lake, whose bed had for years produced profitable crops of beer barley, was this year producing a crop of wild ducks, eared grebes, and Wilson phalaropes.

All along, at the same time that we were seeing these features of the landscape, we were keeping pencil censuses of the birds and mammals that came to view. Diurnal mammals were recorded, as we drove along the roads; and these and signs of mammals were observed in our local circuits afoot. Briefly, these notebook records, and especially the quasi-fresh memory impressions from the whole trip, gave me ground for the following reflections:

Rabbits, both jacks and cottontails, were astonishingly scarce. Long stretches of highway lacked any remains of dead jacks. And incidentally, turkey buzzards were scarce in that corner of California this year. Their highway food source has failed them there, although in other parts of California that I have traversed this spring these birds are in quite normal numbers.

Oregon ground squirrels, in some seasons swarming in the same valleys I had traversed in preceding years, were also at lowest ebb. In the vicinity of Mohawk and Sierra Valley, Plumas County, just two individuals were checked by sight or sound in three days. The most seen were along the east side of Goose Lake, in the vicinity of Sugar Hill, where the land rises sharply from the lake-side flats. At the road crossing of Lassen Creek, as the best example, there were three families of half-grown young conspicuously in evidence. But in the upper Pit River Valley, very few came to our sight or hearing. When we saw photographs of Alturas, taken last December, with rowboats plying up and down the main street, our imagination easily pictured the fate of all flat-land dwellers under extreme flood conditions. And think of the handicap of the Oregon ground squirrels, whose entire population is, in December, lying dormant below-ground!

Interestingly, we saw more individual ground squirrels (*Citellus*) of the digger type (*beecheyi* or *douglasii*) than of the *oregonus* type. In the upper Feather River basin, along the west side of Honey Lake, on the west side of Surprise Valley, and west of Alturas, judging again by memory impression, the population of "diggers" was near normal. In the northeast corner of California, however, they show strong preference for sloping terrain and rimrock, rarely invading even the margins of the flatlands. Marmots also, of like habitat predilections, impressed me as being present in normal numbers. Their usual hibernation quarters may be supposed to be well sheltered from down-pours, or at least well drained.

As to pocket-gophers, sign of which, in the form of winter earth cores, is so conspicuous early in the summer, we gained the impression that they, like the Oregon ground squirrels, were at very low ebb. Territory that I had once trapped, near Beckwith, showed no fresh workings. Around Mohawk and up by Johnsville, where there were still snowbanks, our rambles disclosed only two sets of cores or fresh workings. Here the snow-pack from all accounts had been extraordinarily heavy; a spring thaw had been sudden; indications were that even on well sloped ground there had at one moment been a well-nigh completely covering sheet of water. A guess would be that any burrowing mammal on such ground would be put to extreme hazard not only through drowning even if able to swim, but also on the score of inadequate shelter from cold, as provided normally by its warm and dry subterranean nest. Pocket gophers and other rodents in captivity without nests in which to sleep often die, even in moderate air temperatures. And what of those xerophilous rodents, *Dipodomys* and *Perognathus*, that can swim but little if at all?

Here, then, is a factor, recurrent often in long-time history, that for some kinds of mammals means a prodigious and abrupt reduction in aggregate population. It is *flood*, from quick precipitation (9 inches of rain is unofficially reported in one 24-hour period about December 10 from a place in

Modoc County) or from sudden thaw following exceptional snow-pack, that is effective in this way, rather than high total of annual precipitation. Indeed, this flood factor may dominate, from time to time, any or all other repressive factors. Any potential onset of disease may well be forestalled, or far postponed until populations build up again. Limitation on basis of food-supply may, at such times, be set aside.

Especially for characteristically southwestern types of terrestrial rodents, more or less of the xerophilous category as regards their modes of living and their innate traits of behavior and tolerance, does this flood factor loom in my mind as superimportant in accounting not only for the observed boundaries of geographic ranges of species and races, but also as perhaps the most potent causative factor of observed fluctuations in population numbers. To repeat for emphasis, it is not so much the total precipitation in a given year, that may or may not be an extra wet one, but the way the water comes, that counts in population control.

It is difficult for me to see how this factor for causing great fluctuations in the populations of subterranean mammals can operate on any periodic or cyclic system. It is as nearly a matter of chance as any phenomenon of climate or weather could conceivably be. I have read with great interest Antev's recent paper on "Rainfall and Tree Growth in the Great Basin" (Carnegie Inst. Washington, Publ. no. 469, 97 pp., 1938), but I have also read Harding's paper, "Changes in lake levels in the Great Basin area" (Civil Engineering for February, 1935, pp. 87–90). I am inclined to agree with the latter's conclusions that the recorded fluctuations in annual rainfall are not clearly cyclical. Far less likely is it that the flood factor operates on any regular cyclical schedule. Fluctuations in rodent numbers in the southwest are probably unpredictable.

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A COLONY OF RARE FREE-TAILED BATS

By Adrey E. Borell

A small crevice in a sheer cliff at 6200 feet elevation in the Chisos Mountains of Brewster County, Texas, houses the only colony of *Tadarida macrotis* (Gray) thus far discovered in the United States.

The Chisos Mountains form a biological island separated from any other mountains by desert flats. The surrounding flats vary from 2000 to 3000 feet in elevation. The highest point of the Chisos Mountains is Emory Peak with an elevation of 7835 feet (U. S. Geological Survey Topographic Map, 1905). Above 5000 feet the characteristic species are mainly those of the Arid Transition life zone. The common trees are pinyon, juniper (at least three species), oak (several species), some yellow pine, Douglas fir, aspen, Arizona cypress, little-leaf maple, and madrone. Photographs illustrating the character of the flats surrounding the Chisos Mountains and the higher parts of these mountains are shown by Bailey (1905), plates 5 and 11 respectively.

On May 7, 1937, my attention was drawn to the wall of a narrow canyon by the squeaking of bats. Climbing to the top of a steep talus slope I came to the base of a cliff composed of volcanic rock, in which the bat colony was located. About 40 feet above the top of the talus was a horizontal crack in the rock which appeared to be about 6 inches wide and 20 feet long. There was no possibility of reaching the crevice, so I resorted to a load of fine shot which brought down three specimens of *Tadarida macrotis*. Collections taken from various parts of the crevice indicated the colony was composed entirely of females, most of which were pregnant, and that no other species was present.

At the base of the cliff lay a deposit of guano which extended the full length of the fracture. It was three to four feet wide, and in some places six inches deep. This indicated that the crevice had been occupied for at least several seasons. The droppings, samples of which were saved, are coarse in texture, light in color, and irregular in contour and shape. The larger ones are five to six millimeters long by two to three millimeters in diameter.

The evening of the day on which the bats were discovered I stationed myself in the canyon a mile below the colony and stayed there until after dark. During this vigil I saw no bats which appeared to be the large free-tails.

In order to determine the approximate number of bats in the colony and the time of leaving the roost I returned to the site the next evening before sunset. A pair of white-throated swifts flew repeatedly in and out of one end of the crevice, where apparently they were nesting. At intervals the bats did a great deal of squeaking, especially when the swifts flew past the main entrance of the fracture. At 7:40 P.M. *Pipistrellus* began to forage and as it became darker other small bats appeared, but it was not until 8:20 that

the first large free-tails left their roost. Although I had been sitting at the base of the cliff since sundown and my eyes had opportunity to become adjusted to the growing darkness, I was unable to see to walk even before the first *macrotis* left the roost. No one had been near the cliff during the day and I was careful not to disturb the bats with noise or light, therefore the evening flight should have been normal. This observation sustains the opinion that some of our supposedly rare bats are seldom collected because they forage only after it is too dark for us to see them. The bats left in small groups during a period of 15 minutes, and as nearly as I could count they numbered about 130. The swish of their rapid flight as they took wing was very noticeable; but it was too dark to determine whether they departed up or down the canyon. They were visible for only a moment while silhouetted against the sky. The crevice was so located that the bats had an unobstructed drop of about 30 feet when taking flight.

At a water tank on the west base of the Chisos Mountains at 3500 feet elevation, I had trapped, during the previous two weeks, 286 bats of five species, but among them there were no large free-tails. This might indicate that *Tadarida macrotis* is either rare in the Chisos Mountains area or that it forages above 3500 feet elevation.

The ten specimens obtained were females and eight of these contained one embryo each. The largest embryo was 14 mm. long and the smallest 11.7 mm., in their natural curled position.

On October 19, 1937, with James O. Stevenson, I again visited the site and found the bats still present. In order to gain further information 8 additional specimens were collected.

Examination of the ten specimens taken May 7, revealed only one external parasite. Dr. W. B. Herms, Division of Entomology and Parasitology, University of California, Berkeley, California, wrote me under date of September 17, 1937, that Mr. R. L. Usinger, of the same Division, has tentatively identified the parasite as a new form of the bat bug *Hesperoctenes*. From the eight bats taken on October 19, two additional specimens of *Hesperoctenes* and one flea were obtained. Dr. M. A. Stewart, of the same institution wrote on July 19, 1938 that the flea is a new species of the genus *Ischnopsyllus*.

According to literature available to me, there have been previously only 8 specimens of *Tadarida macrotis* obtained in the United States. There is one record from each of the following states: Arizona, Nevada, Utah, and Colorado; and two each from California and Iowa.

Since so few bats of this species have been obtained in the United States it previously has been impossible to present measurements of a series of adults from any one locality. Following are measurements in millimeters of ten adult females which were collected May 7, 1937, at the locality described above:

	EXTERNAL MEASUREMENTS		
	Average	Minimum	Maximum
Total length	133.8	129.0	138.0
Tail	51.0	48.0	54.0
Foot	9.2	9.0	10.0
Ear from crown	25.4	24.0	26.0
Head and body	82.4	77.0	88.0
Wing spread	417.0	407.0	432.0
Forearm	60.7	58.3	63.4
Thumb (dried skins)	7.2	6.8	8.2
Tibia	17.3	16.8	18.0
Exposed portion of tail	29.0	25.0	33.0
	CRANIAL MEASUREMENTS		
	Average	Minimum	Maximum
Total length	23.1	22.7	23.7
Zygomatic breadth	12.5	12.3	12.9
Interorbital breadth	4.2	4.1	4.4
Occipital depth	7.8	7.6	8.0
Breadth of brain case	10.2	10.0	10.5
Basal length	20.3	19.8	20.6
Maxillary tooth row	8.9	8.7	9.2
Breadth at second molars	7.2	7.0	7.5
Breadth at canines	5.3	5.2	5.5
Length of mandible	16.1	15.8	16.5
Mandibular tooth row	9.5	9.2	9.9

The ten skins taken on May 7 show considerable color variation. Dorsally the color ranges from a light reddish brown to a rich dark brown. The ventral surfaces also show individual color variation, but in every specimen the under parts are lighter than the back. The hair is whitish at the base, this character being especially noticeable on the dorsal surface. The hair is considerably longer than that of *Tadarida mexicana* taken in the same area.

Three of the specimens taken on October 17 were the same color as those taken on May 7, but five of them are much darker. I am inclined to believe that the dark ones are young of the year but the teeth of the lighter ones were so little worn that age determination is not certain.

In discussing the *macrotis* group, Shamel (1931, p. 11) stated that there is a conspicuous fold of membrane which forms a pocket at the angle of the tibia and the femur, on the under surface. The ten specimens examined showed this character only very slightly in the flesh, and most of the dried skins present no trace of it.

Skulls of the Texas series differ from Shamel's description in that all of them possess deep (2 mm.), narrow, emarginations in the anterior portion of the palate. In a letter of September 16, 1937, Mr. Shamel advised me that

his statement (op. cit. p. 11) regarding the lack of anterior palatine emarginations was an error. The upper incisors are about 5 mm. apart; in most specimens they converge slightly toward the tips.

I can distinguish no difference between skulls or skins of the two specimens which contained no embryos and the eight pregnant females. That is, the two non-breeding females appear to be fully mature but not extremely old.

These specimens will be depositied in the collections of the National Park Service, Washington, D. C., the National Museum, Washington, D. C., and the Museum of Vertebrate Zoölogy, Berkeley, California.

I am indebted to Mr. H. Harold Shamel, of the United States National Museum, who verified identification of these bats, and to Mr. W. B. Herms, of the University of California, for identification of the parasites.

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FALL FOOD HABITS OF THE RACCOON IN CENTRAL IOWA[1]

BY LEROY W. GILES

During the fall of 1937, studies were made of the food habits of the eastern raccoon, *Procyon lotor lotor* (Linnaeus), in the vicinity of Ames, Iowa. The types of food eaten were determined by an analysis of fecal remains; and to make the results more comprehensive, a quantitative index was obtained by volume measurement (Selko, 1937). A total of 67 fresh scats was collected between September 14 and November 14. Most of these were picked up just north of Ames in a distance of about five miles along Squaw Creek, a small stream running through Ames from the northwest. The stream margins are moderately wooded whereas the surrounding country is largely under cultivation with some pasture. Four scats were found on Skunk River 8 miles northeast of Ames.

The scats were found on logs or at the base of trees, all within the distance of a rod of the stream bed, and either singly or in accumulated piles, the so-called "coon latrines."

The work was carried on in connection with studies in raccoon ecology and

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Iowa State College, in cooperation with the U. S. Biological Survey, the American Wildlife Institute, and the Iowa State Conservation Commission.

management under the supervision of Dr. George O. Hendrickson, Assistant Professor in Wildlife Management, Iowa State College, and Dr. Logan J. Bennett, Biologist, U. S. Bureau of Biological Survey.

Three items constituted the bulk of the food. These three, namely, corn, crayfish, and hackberries, together made up 87.49 percent of the total fecal material. Other foods were present generally in small quantities. In the individual scats, except in a very few instances, they formed only a small percentage of the contained material. In the table summarizing the food percentages the last column gives an estimate of the percentage of actual food obtained in each food class.

There was a large acreage of corn generally distributed along the area. All of the fields were within 35 rods of the stream. Corn was the most abundant food and was readily available throughout the fall. In relation to the other foods taken there was a decided increase in its consumption as the season advanced. It constituted 27.67 percent of the total food remains in scats

TABLE I. PERCENTAGES OF FOOD OCCURRENCE

TYPE OF FOOD	FREQUENCY OF OCCURRENCE IN PERCENT	PERCENTAGE OF TOTAL FOOD REMAINS	PROBABLE ACTUAL FOOD PERCENTAGE
Corn	80.60	41.05	68.50
Crayfish	70.15	24.50	16.35
Hackberries	37.31	22.67	9.20
Other fruit	30.00	9.57	4.25
Insects	47.76	1.39	.70
Vertebrates	6.00	.83	1.00

collected in September, while it made up 31.26 percent of the total in October and 83.31 percent in November. Corn was present in 80.60 percent of all the scats found and made up 41.05 percent of the entire food remains. Quantitatively it was the most important food.

Crayfish ranked second in importance. They occurred in 70.15 percent of the scats and made up 24.50 percent of the fecal remains. They were eaten throughout the fall though in diminishing quantities as cold weather set in.

Hackberries had only a short seasonal appeal. During the last of September and the first half of October large fecal masses composed almost entirely of the heavy, indigestible seeds and skins of the fruit were common and quite conspicuous on logs lying near the water. In places hackberry trees made up as much as 5 percent of the wooded areas bordering the stream. Hackberries appeared in 37.31 percent of the scats collected and comprised 22.67 percent of the total volume.

Other wild fruits were eaten in smaller amounts. They occurred in 30

percent of the scats and, collectively, made up 9.57 percent of the fecal material. Of this total 34.02 percent was wild plum; 32.42 percent, wild cherry; and 24.32 percent was wild grape. Redhaw (*Crataegus* sp.) was present in three scats in negligible quantities although the fruit itself was quite abundant on the area.

Insect remains occurred in 32 of the 67 scats. Their entire volume, however, was only 1.39 percent of the total. Twenty-two, or approximately two-thirds, of the insect-containing scats yielded only traces of insect remains, amounts too small to warrant measurement. Except for a trace of cockroach and two indeterminate fragments, beetles and grasshoppers represented the insect food. Two species of grasshoppers could be identified and they incuded 91 percent of the insect remains present. *Melanoplus differentialis* was the most common and occurred in nine scats; the other, *M. femur-rubrum*, was present in 4 scats. Of the Coleoptera remains, ground beetles (*Carabidae*) were the most prevalent. They occurred in 13 scats. Only 4 of the larger, more conspicuous species could be identified. *Harpalus caliginosus* was found in one scat, *Calosoma scrutator* in one, *Carabus serratus* in one, and *Cychrus elevatus* in one. Lamellicorn beetles occurred in 3 scats. *Pelidnota punctata*, *Lucanus dama* and a species of *Phyllophaga* 39 percent of one scat, while *Phyllophaga* sp. occurred as traces in the 2 others. The other remains present were those of aquatic beetles; *Dytiscus* sp. occurred in 2 scats and *Hydrous triangularis* in two.

Only 4 scats showed vertebrate remains. The fur and bone fragments of muskrat, *Ondatra zibethica*, made up 60 percent of one scat found in September. A few feathers of bluebird, *Sialia sialis*, appeared in one scat.

The remaining inclusions were in such small quantities that they were probably of no importance as food. Oats occurred twice. Weed seeds, particularly hemp, *Cannabis sativa*, appeared in 3 scats, though there were only one or two seeds in each case.

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NOTES ON THE SOUTHERN WOODCHUCK IN MISSOURI

By A. R. Twichell

The A. M. thesis, of which the present paper summarizes only the salient points, is now on file in the library of the University of Missouri. It is based on field observations and laboratory work on *Marmota monax monax*; most of the latter consisted of post-mortem examinations. The study was carried on in central Missouri within a twenty-mile radius of Columbia, from June 1937 to July 1938.

The area studied offers a variety of topographic and cover conditions, from the flat prairie in the north to the limestone bluffs along the Missouri River in the southwest, with steep, rocky hills and more gently rolling land between. Much of the area is wooded, and some of the woodlands are pastured. A variety of crops is raised, most of the fields being irregular in shape and less than 40 acres in size. Much of the area is cut-over land which is not under cultivation, and in some places erosion-gullies have made further cultivation impracticable.

Woodchuck dens were identified by the presence of tracks, hair, or odor, by the animal's characteristic habit of expelling dirt from the den almost daily, and by the paths and cropped vegetation near the entrances. A pair of eight-power binoculars was used to study the activities of the animals. Other equipment used included a steel tape, a flashlight, and digging tools.

Two adult females and two immature woodchucks were kept in captivity for observation and feeding experiments. These animals, taken from excavated dens, were captured by means of a noose on the end of a stick.

Dens.—The highest concentration of dens was found in gullies and creek banks. Thirty-four percent of the 132 dens investigated were on slopes of between 30 and 45 degrees; 37 percent were on more gradual slopes and 29 percent were on steeper slopes. There was no evidence of preference in the matter of direction of slope.

More dens were found in rocky soil than elsewhere; none were found in the prairie soil of northern Boone County (central Missouri). Ninety-nine (75 percent) of the 132 dens were in woodland, and about a third of these were in pastured woods. Only one den was found within the borders of a cultivated field (in this case, alfalfa), although 76 (58 percent) were situated within 100 feet of cultivated fields. Apparently the gullies and creek-banks adjacent to most cultivated fields in this region afford better and safer den sites.

Although woodchucks usually dig their own dens, a number were found using natural caves along the Missouri River bluffs and in a few other localities. In one reported case, a mother and several young denned in a fallen hollow log.

Five dens which were excavated showed no great uniformity of structure. The number of entrances varied from 2 to 6; the number of nests from 0 to 3, and the number of blind branches from 0 to 5, their length varying between 1.5 and 12 feet. The total length of all the passageways in a den varied between 14 and 45 feet. The nests were made of leaves or grass. Feces were found in small pits near three nests, and in the passageways in only one den where they appeared to be the droppings of two immature animals dwelling there. The evidence supports Hamilton's opinion (1934, p. 109) that the woodchuck "is a cleanly animal and meticulous about its toilet."

It is often impossible to be sure how many entrances a woodchuck den has without opening it, for, as Audubon and Bachman long ago pointed out (1849, p. 23), young woodchucks when a few months old begin to dig tunnels near their homes, many of them only a few feet long. However, I attempted to learn whether nearby openings led into a common passageway by exploring them with a flashlight and a long stick. The average number of true entrances was found to be 2.8; the maximum number was ten, the minimum one; 80 percent of the 132 dens had from one to three entrances.

Non-colonial habit.—Neither the writer nor anyone else in this region has ever found more than two adults in a single den, though Hamilton wrote (1934, p. 96) that "there may be as many as three or four in the hole at the same time."

Population-density.—W. L. Henning, in a vertebrate survey of the 2220-acre Ashland Experimental Area in southern Boone County in 1936–1937, found a summer population-density of one woodchuck to 36 acres; the greatest density, on the Baxter stony soil, was one to 11.5 acres. Nothing has been found here even remotely approaching the density which Hamilton (1934, p. 92) found in New York State, where 30 occupied dens were found in three acres and 11 in less than one acre.

Cruising-radius.—I have seen a woodchuck as much as 100 feet from its hole only once. On this occasion the paced distance was 75 yards. Hamilton (1934, p. 109) said that rufescent woodchucks "commonly travel a hundred yards from the den and may go an eighth of a mile when suitable food plants are not readily available." This particular problem is complicated by the fact that although a woodchuck may never go far from its den, it may have several dens and may thus be able to travel a considerable distance while always near a place of refuge. Hamilton tells (1934, p. 108) of a woodchuck that travelled 270 yards in a half-hour while it fed intermittently; during this time it entered three widely-separated burrows.

The general opinion that woodchucks return to the woods to "den up" for the winter is supported by the present observations.

A mature woodchuck that escaped from captivity onto the University of Missouri campus on April 3, 1938, was recaptured on June 9 only 120 yards from where it had last been seen two months before. A young animal was

released on June 3, 1938, on a fenced quarter-acre of land bounded on two sides by city streets and on the other two by university buildings and plowed land where the campus is being prepared for reseeding. After eight weeks this woodchuck is seen almost daily. It is growing rapidly on the natural food in this small area and is apparently as shy as woodchucks in more remote places.

Food and feeding.—Among our captive animals the order of preference for wild foods was (1) wild lettuce (*Lactuca scariola*), (2) white clover (*Trifolium repens*), (3) red clover (*T. pratense*), (4) grasses (*Poa* spp.), and (5) sweet clover (*Melilotus alba*). After the sweet clover had blossomed it was eaten even more sparingly than before. The average daily consumption of wild lettuce by one animal over a five-day test period was 23 ounces, as compared with only 13 ounces of white clover. Since our woodchucks lost weight during captivity, it is likely that in nature the consumption is heavier than these figures indicate.

Time of activity.—The period from an hour before sunset to dusk is the most favorable for seeing the animals. I have never found them out after dark, though Hamilton (1934, p. 103) says that in March woodchucks are probably out by night as much as by day.

Watchfulness.—While feeding, the woodchuck spends nearly half of its time looking about. At times it "freezes" in position, but I have never seen it hold one position for more than a minute before moving—usually to make a dash for its hole. One startled woodchuck was seen to run across the corner of a muddy field. The imprints of all four feet were found to be very close together, in some cases overlapping. The distance between successive sets of tracks was 25½ inches, 33 inches, and 34 inches. Hamilton (1934, p. 93) says that the distance between successive sets of tracks when the animal is running is "normally twelve inches."

Hibernation.—On February 6, 1938, I found three woodchuck dens that had recently been cleaned out by the animals. On the same day, two nonhibernating woodchucks were found in a single den in an adjoining county by men collecting for Dr. L. J. Wells, Department of Anatomy, University of Missouri. From that date on, woodchucks and signs of their activities were frequently found.

The beginning of hibernation in Missouri is less easy to place, since in the autumn the animals come out infrequently and for progressively shorter periods. During most of October there were some signs of woodchuck activity, but no animals were seen. No animals or signs were found during November, December, and January. However, woodchucks in this region do occasionally emerge during the winter: Mr. W. O. Nagel, Research Associate, saw one on the Ashland Experimental Area on November 20 and again on December 1, 1936. Mr. Henning saw one there on December 3, 1936.

Breeding season.—The breeding season begins very soon after the animals emerge in the spring. In central Missouri the 1938 breeding season began during mid-February. Farther north the season is later; Rasmussen (1918, p. 378) says that in the vicinity of Ithaca, New York, woodchucks become permanently awake during the second half of March and that most of the females soon become pregnant. Embryos were found *in utero* on February 27, March 20, March 23; the diameter of the uterus at the point of implantation was 17.8 mm. in the first case, 20 mm. in the last.

May 22, 1938, was the earliest date on which I found young woodchucks outside of the den. One of these was 13.4 inches long and weighed 15 ounces; the other weighed 20 ounces and was slightly longer than the first, though it escaped before being measured. Judging from the descriptions and illustrations given by Hamilton (1934, pp. 118, 172) they were about eight weeks old.

Parasites.—The only external parasites found were ticks, *Ixodes texanus*. These were almost always present but were never numerous; the largest number found on a single animal was six. In contrast, Hamilton (1934, p. 148) found as many as 69 ticks, *Ixodes hexagenia cookei*, on one woodchuck.

The only internal parasites found in 19 animals examined were roundworms identified as *Obeliscoides cuniculi* by the Bureau of Animal Industry, Washington, D. C. Two of these were attached to the mucosa of one stomach, six to that of another.

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DISTRIBUTION NOTES ON CERTAIN VIRGINIA MAMMALS

By Clyde P. Patton

A preliminary investigation started in September, 1936, by the Virginia Coöperative Wildlife Research Unit to determine the distribution of mammals in Virginia has yielded new information worthy of record. Approximately three hundred specimens collected at various localities in the State during this study, and the Virginia material contained in the Academy of Natural Sciences of Philadelphia and the United States National Museum (including the Biological Survey collection) have been examined. They provide reason for the inclusion of one species and three subspecies not heretofore recorded from Virginia. In addition, new data relative to the range of one species and four subspecies have been brought to light.

I am indebted to Mr. Gerrit S. Miller, Jr. for the unlimited use of the mammal collection in the United States National Museum, to Mr. Wharton Huber for the use of the mammal collection in the Academy of Natural Sciences of Philadelphia, and to Mr. A. H. Howell for verifying the identification of specimens.

Cryptotis parva (Say). Formerly known to occur only in the lower Piedmont Plateau and Coastal Plain regions in Virginia. A female specimen collected August 13, 1936, at Blacksburg, Montgomery County (altitude 2,100 feet), and deposited in the collection of the Virginia Coöperative Wildlife Research Unit, provides definite evidence that this shrew occurs in the Allegheny Mountain region and extends the animal's range westward in the State more than 60 miles. Periodic collecting in the mountain region during the past two years has failed to produce other specimens, indicating that this species is very rare at higher altitudes in Virginia.

Mustela rixosa allegheniensis (Rhoads). An adult male specimen in summer pelage collected at Blacksburg, Montgomery County (altitude 2,100 feet) October 31, 1936, and contributed to the United States National Museum, Biological Survey collection, establishes with certainty the occurrence of *Mustela rixosa allegheniensis* in the Allegheny Mountains of Virginia. It is apparently the first record for this animal in the State. On April 6, 1937, in the same locality at which I captured the above specimen, I observed another of these animals in summer pelage sitting close to a rail fence, apparently sunning itself under the protection of bare blackberry and poison ivy vines. I observed it in this position only for an instant, when it caught sight of me and disappeared into the matted vegetation growing along the fence.

Tamiasciurus hudsonicus abieticola Howell. A search of the literature has failed to reveal published records for this race in Virginia. A specimen taken June 10, 1938, on Bear Mountain, Highland County (altitude 4,400 feet) in a *Picea-Tsuga* association and a series of five specimens in the United States National Museum from Mount Rogers, Grayson County (altitude 5,719 feet) are referred to *abieticola*. They provide evidence of its occurrence along the upper slopes in the lower Canadian Zone of the Allegheny and Blue Ridge mountains of the State. I have two records of the red squirrel, probably of this form, seen in hemlock trees near water at Mountain Lake, Giles County (altitude 3,873).

Sciurus carolinensis carolinensis Gmelin. Formerly this race of gray squirrel was thought to range throughout the State, but study material examined during this investi-

gation indicates that *S. c. carolinensis* occupies the southern half of the Piedmont Plateau and the entire Coastal Plain region, intergrading with *S. c. leucotis* on the north and northwest. Five skins from Hampstead, King George County, in the United States National Museum are not typical of either the northern or southern form; they may best be classed as intermediates. Likewise, four intermediate specimens from Buckingham County are contained in the Academy of Natural Sciences of Philadelphia. It is evident that in Virginia the area of intergradation between *S. c. carolinensis* and *S. c. leucotis* lies along a line drawn from central King George County to southeastern Patrick County; however, additional study material from the latter region should be examined to substantiate this. Specimens from the Dismal Swamp, Norfolk and Nansemond counties; Eastville, Northampton County; and Suffolk, Nansemond County, in the United States National Museum, and one from Charlotte Court House, Charlotte County in the collection of the Virginia Coöperative Wildlife Research Unit, are nearer *carolinensis* than *leucotis*.

Sciurus carolinensis leucotis (Gapper). Insofar as I can learn, Vernon Bailey (1929) writing of the mammals of Bath and Highland counties, gives the first and only record of the occurrence of this race as far south as Virginia. During this investigation, material examined and referred to *S. c. leucotis* shows quite definitely that its range includes the mountain region south to Montgomery County and the Piedmont Plateau to Orange County. Areas of intergradation with *S. c. carolinensis* in the Piedmont Plateau region have been discussed above. It is probable that the distribution of *leucotis* will eventually be found to extend farther south in the mountains of Virginia and possibly into those of North Carolina.

Specimens examined: Alexandria County, 1; Belvoir, Fauquier County, 1; Falls Church, Fairfax County, 9; Four Mile Run, Arlington County, 1; Loudoun County, 3; Nelson County, 3; Paris, Fauquier County, 11; Peaks of Otter, Bedford County, 7; Washington, Rappahannock County, 1; Wilderness, Orange County, 2; collection of United States National Museum. Blacksburg, Montgomery County, 1; Mount Solon, Augusta County, 1; collection of Virginia Coöperative Wildlife Research Unit.

Peromyscus nuttalli nuttalli (Harlan). A typical specimen of *Peromyscus nuttalli nuttalli* collected November 19, 1935, at Blacksburg, Montgomery County (altitude 2,100 feet), and contained in the collection of the Virginia Coöperative Wildlife Research Unit, extends the range of this race 300 miles or more to the westward, into the mountains of Virginia.

Twelve specimens from Amelia Court House, Amelia County, in the Biological Survey collection, are somewhat paler than typical specimens from the Dismal Swamp.

Clethrionomys gapperi gapperi (Vigors). A search of the literature has failed to reveal records of this race as far south as Virginia. However, it is known to occur in boreal spots in the Allegheny and Blue Ridge mountains of the State. One trapped February 8, 1938, from a *Rhododendron-Kalmia-Tsuga* association at Mountain Lake, Giles County (altitude 3,873 feet), and a series of five specimens in the United States National Museum from other similar localities, agree in character with specimens from localities further north. These records provide conclusive evidence of the occurrence of *C. g. gapperi* in Virginia and apparently represent an extension of its range from Pennsylvania south through the Allegheny and Blue Ridge mountains to Giles County, Virginia.

Specimens examined: Mountain Lake, Giles County, 1; collection of Virginia Cooperative Wildlife Research Unit. Elliott Knob, Augusta County, 1; Peaks of Otter, Bedford County, 1; Stokesville, Augusta County, 1; Washington, Rappahannock County, 2; collection of United States National Museum.

Ondatra zibethica zibethica (Linnaeus). According to a map by Hollister (1911) the southwestern mountain region of Virginia is included in the range of this form. Since no Virginia specimens are listed, this range is apparently given on the basis of specimens

from the mountains of West Virginia and North Carolina. A specimen collected in January, 1937, at Blacksburg, Montgomery County (altitude 2,100 feet) and referred to *O. z. zibethica* apparently gives the first conclusive evidence for this race in Virginia and makes available additional study material to substantiate Hollister's (1911) range.

Napaeozapus insignis roanensis (Preble). This bright colored jumping mouse is known to occur in wooded boreal spots in the Virginia Allegheny and Blue Ridge mountains from southern Grayson County to northern Augusta County. It was first recorded from the State by Greenfield (1938) who took two specimens from snake stomachs collected in Augusta County. A specimen trapped June 18, 1937, near Mountain Lake, Giles County (altitude 3,600 feet), and those in the United States National Museum from Mount Rogers, Grayson County and Eggleston, Giles County, agree in color with specimens from the type locality, and show definitely that this form occurs in the southern mountain region of the State.

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NOTES ON THE MAMMALS OF ROWAN AND ADJACENT COUNTIES IN EASTERN KENTUCKY

By Wilfred A. Welter and Dwight E. Sollberger

Rowan County is typical of the eastern mountainous section of Kentucky. The hills are steep and heavily eroded while the valleys are usually narrow and subjected to periodical flooding. The vegetation has not been able to establish a thick humus because of erosion and also because of systematic burning of the leaves and underbrush. Since the establishment in 1930 of the Cumberland National Forest, part of which is in Rowan County, and its protection by the C. C. C., the areas are no longer burned. This has resulted in a noticeable increase in all forms of wild life.

Garman (1894) published a preliminary list of vertebrates of Kentucky in which he enumerated 25 species of mammals. Funkhouser (1925) listed 42 native species exclusive of those which had been exterminated. The available data on the eastern section when these lists were compiled were less abundant than for other parts of the state. Hamilton (1930) published a list of the mammals of Breathitt County which constitutes the first published list from the mountains of Kentucky. Because of the apparent shortage of

material from the mountains, the following notes, obtained during the last six years, may prove useful. Questionable forms were identified at the United States National Museum, and specimens collected are deposited in the museum at Morehead State Teachers College.

Didelphis virginiana virginiana Kerr.—Opossum. Opossums are found throughout the region studied, especially in the low lying districts. They are frequently found dead on the highways. A litter on the back of a female was observed June 15, 1938. Local residents go 'possum' hunting from November to January and find the animal's flesh quite palatable.

Parascalops breweri (Bachman).—Hairy-tailed mole. This species is not as common as *Scalopus aquaticus;* but numerous specimens have been taken in the low, often flooded areas along Triplet Creek near Clearfield, Kentucky.

Scalopus aquaticus machrinus (Rafinesque).—Prairie mole. Numerous specimens have been taken from lawns and gardens. This species is regarded as a pest by local residents as its tunnelling activities cause considerable damage.

Sorex fumeus fumeus Miller.—Smoky shrew. Apparently this species is not common. A single specimen was picked up dead on top of a hill near the C. C. C. Camp one mile east of Morehead.

Cryptotis parva (Say).—Little short-tailed shrew. This shrew is an inhabitant of old fields and pastures where it makes its runways beneath rocks. A female and a litter of six nearly grown young were taken from a nest of dried grass beneath a roughly circular flat rock thirty inches in diameter on April 16, 1938. The weight of the adult female the day following capture was 5.4 grams. The weight of the combined litter of six was 17.5 grams making an average of 2.91 grams per individual young. When first captured, the young fed entirely from the mother, but during the following week, they learned to eat ants, ant pupae, and crickets which were first killed by the parent. On April 18, it was definitely established that the eyes of the young were open. The litter was kept for five days with little change in weight although the young became better able to care for themselves during this period. Finally two young were eaten by the parent and others in the litter, and it was thought best to preserve the remainder of the group.

When killing crickets the adult female gave a few vigorous bites on the head and then moved to another kill. In this manner six crickets were killed while none were eaten until later.

Attention is called to the weight of the litter, the individuals of which for two days were observed to feed entirely from a parent weighing one-third as much as the combined group.

Another specimen was obtained from the stomach of a blowing viper, *Heterodon contortrix*, collected on Clack Mountain near Morehead, Kentucky. Another was collected in a pasture in Morehead.

Blarina brevicauda talpoides (Gapper).—Short-tailed shrew. This is by far the most common shrew in the region. Specimens were taken in brush areas, orchards, damp meadows, and open fields. Seven shrews and 40 white-footed mice were taken with 120 traps during one night of trapping at Carter Caves in Carter County.

Myotis lucifugus lucifugus (Le Conte).—Little brown bat. This species is fairly common during the summer months. About 5000 hibernate each winter in Carter Caves in Carter County in company with *M. sodalis*.

Myotis sodalis Miller and Allen. A colony of more than 90,000 bats of this species hibernate in Bat Cave in Carter County each winter. Two thousand individuals of this species and *M. lucifugus* were marked with Biological Survey bird bands in April 1937, to study migration and longevity. This was but a short time before the bats left the cave for the summer. In November 1937, many of the clusters of bats were examined

and 70 banded individuals were found. The banded bats now were scattered through all the clusters in a large room in the cave. In banding, the year before, all bats banded were taken from five large clusters from one restricted area in the cave.

Lasionycteris noctivagans (Le Conte).—Silver-haired bat. A single specimen of this species was taken in Morehead on March 29, 1938. It is rare in this section. Funkhouser (1925) recorded a specimen from Bell County.

Pipistrellus subflavus subflavus (F. Cuvier).—Pipistrelle. This is one of the commonest bats in the county, being exceeded in numbers only by the red bat. It has also been found hibernating in small numbers in Bat Cave at Carter Caves. The average measurements of two males are: Length, 70, tail, 29; foot, 9.5; forearm, 30; tragus, 6.

Eptesicus fuscus fuscus (Beauvois).—Big brown bat. Not at all common in Rowan County although Hamilton (1930) found this to be one of the most common species in Breathitt County. Specimens were obtained near Morehead. A few individuals hibernate in Bat Cave each year.

Lasiurus borealis borealis (Müller).—Red bat. This is the commonest bat observed during the summer. Early in the evening they are first observed flying so high in the air that they are barely visible. As darkness approaches they fly lower and lower until they skim over the underbrush. Average measurements of five females are: Length, 103.6; tail, 48.2; foot, 8.8; forearm, 38.8; tragus, 6.

Corynorhinus rafinesquii rafinesquii (Lesson).—Big-eared bat. On December 12, 1932, a single individual was collected at Carter Caves. This bat was not in the interior of any of the caves but was hanging in a crevice which received considerable light. Apparently it was hibernating, as the guide had seen it in the same location on several days before it was collected. Hamilton recorded a single specimen for Breathitt County.

Procyon lotor lotor (Linnaeus).—Raccoon. This species was abundant formerly. Individuals are seldom encountered at present although a number still exist in the region. Stringent regulations will be necessary to preserve the species.

Mustela frenata noveboracensis (Emmons).—New York weasel. An individual was killed in a chicken yard along Triplet Creek at Clearfield. Occasionally they are reported by farmers as visiting hen houses. A few are still obtained by trappers.

Mustela vison mink Peale and Beauvois.—Mink. The mink was more abundant formerly than at present. Trappers occasionally obtain specimens.

Spilogale putorius (Linnaeus).—Spotted skunk. This species has not been encountered in the county by either of the writers; but fur dealers speak of a small spotted skunk which is sometimes taken.

Mephitis mephitis nigra (Peale and Beauvois).—Common skunk. Skunks are not very abundant but a number are taken each winter. It is unusual to find a dead individual on the highway. The species appears to be more common north of Morehead near the Fleming County line than in other sections. A female and five young about one-third grown were observed during the first week of June, 1934.

Vulpes fulva fulva (Desmarest).—Red fox. The red fox is much more common to the west in the bluegrass than it is in the hilly sections. A den with young was found in late May near Owingsville in Bath County. Fox hunters in Rowan County have difficulty in finding red foxes for their chases. They are much preferred to the grays, which have a tendency to hole-up when hard pressed by hounds. The red fox is protected by the fox hunters of the region; so its future is assured.

Urocyon cineroargenteus cineroargenteus (Schreber).—Gray fox. This fox is common in the rocky ridges of eastern Kentucky. It is sometimes seen along the highways and often makes depredations on farmers' poultry yards. A young male was killed by an automobile on the outskirts of Morehead early one evening and was brought to the laboratory while still warm.

Lynx rufus rufus (Schreber).—Bobcat. A mounted specimen which was taken near

Clearfield was examined. Several specimens have been captured near Morehead in the last five years. An occasional individual is reported from time to time from Lochege and Clack Mountain. Farmers along the North Fork of Licking often report hearing wildcats. One was trapped in Bat Cave three hundred feet from the entrance.

Marmota monax monax (Linnaeus).—Woodchuck. Woodchucks are fairly common in the cliffs and rocky areas along the ridges. Many are seen along the C. C. C. trail over Clack Mountain. Two specimens in the Morehead State Teachers College Museum were taken from this locality. A young individual less than one-third grown was brought into the laboratory during the third week of May.

Tamias striatus fisheri Howell.—Fisher chipmunk. This form is very abundant throughout the region. Hamilton lists *striatus* as the form from Breathitt County, but Dr. Remington Kellogg has identified the specimens from this region as *fisheri*.

Sciurus carolinensis carolinensis Gmelin.—Gray squirrel. Heavy hunting in and out of season has depleted the squirrel population to a considerable degree. A pair is occupying the hillside back of the college, but this is the only pair that has been encountered near Morehead for several years. They are rather common along Licking River near Farmers, and are also more abundant in Fleming than in Rowan County. Numbers can still be seen feeding any evening in the small remaining stand of virgin timber at Carter Caves. The season opened on July 1 this year, and the hunters still manage to obtain good bags.

Sciurus niger rufiventer Geoffroy.—Fox squirrel. This species is not at all common at the present time. Occasionally an individual is taken by a hunter. One specimen in the Morehead State Teachers College Museum was killed by a dog. The species is frequently seen in small stands of hickory in the bluegrass region to the west of Rowan County.

Glaucomys volans volans (Linnaeus).—Flying squirrel. This squirrel is very abundant in the region. A number of individuals enter a linen closet in one of the college dormitories each year and become pests. A gravid female was captured there on July 26, 1938, while five other individuals, possibly the first litter of the season, escaped. Young two-thirds grown have been taken in early April, indicating that the first litter is born in late January or early in February. It is very likely that three litters are raised each year in eastern Kentucky.

Reithrodontomys humulis humulis (Audubon and Bachman).—Southern harvest mouse. Howell in his revision of the American harvest mice records three specimens of *R. h. merriami* from Lexington, Kentucky. To the writers' knowledge there are no other published records of any form of *Reithrodontomys* for the state. According to Kellogg (correspondence), Howell's record as well as the specimens obtained at Morehead should be referred to *R. h. humulis*. Eight specimens were obtained in Rowan County. Two were taken in the Van Antwerp orchard in rather dry ground among the rows of trees, and six in the marsh beyond the Morehead State Teachers College athletic field. The traps were set in runways which could not be distinguished from those of meadow mice. The species is not common, judging from the few individuals taken.

Peromyscus leucopus noveboracensis (Fischer).—Northern white-footed mouse. This is the most common species of woodland mammal in this section. Specimens have been taken from all stations. Occasionally an individual was secured in rather open fields.

Peromyscus nuttalli nuttalli (Harlan).—Northern golden mouse. The golden mouse is less numerous than the white-footed mouse, but nevertheless it can be considered a common woodland form. It has been taken most frequently in pine thickets on level ground, particularly around old fallen pine trees. The nests are rather carefully woven structures placed in bushes or briars several feet from the ground. These nests are

easily found and as many as three adults have been taken from a single nest. A nest containing five small naked young was collected on April 15.

Neotoma pennsylvanica Stone.—Allegheny cliff rat. Wood or cliff rats are very common along the rock ledges near the tops of the ridges. Two specimens were secured in deadfalls and one was captured in a mouse trap. Tracks, droppings, and an accumulation of all sorts of debris bear testimony to the presence of these interesting rodents among the rocky cliffs.

Synaptomys cooperi stonei Rhoads.—Stone mouse lemming. Two specimens of this species were obtained near the Morehead State Teachers College athletic field. It is believed that they constitute the first record for the state. One was found beneath a stone in a dry grassy area which was near a low-lying grassy marsh grown up to alders, sedges, and swamp grasses. Sphagnum was present in the marsh. The other specimen was caught in a trap near this marsh. Traps were kept out for several days and no additional specimens were obtained. Meadow and harvest mice were taken from the same locality. Another sphagnum marsh at the Van Antwerp orchard, eight miles west of Morehead, was trapped for lemmings without success.

Microtus pennsylvanicus pennsylvanicus (Ord.).—Meadow mouse. This mouse was taken in a grassy area near the Morehead State Teachers College athletic field and in Van Antwerp's orchard. Hamilton (1930) reported no meadow mice for Breathitt County. It is certainly a common species in grassy fields and meadows in this section.

Pitymys pinetorum auricularis (Bailey).—Southern pine mouse. Four specimens were taken in pine thickets in low lying ground near the C. C. C. Camp at Rodburn. Many of the runways were merely burrows beneath the dry leaves and needles while others actually were subterranean in nature.

Ondatra zibethica zibethica (Linnaeus).—Muskrat. Several specimens were trapped in Triplet Creek near the entrance to Licking River. The river banks at this point were worn smooth by the animals. The species is very common at Lewis Pond where they make daily visits to the nearby corn fields. Well travelled paths connect the pond to the fields. It is also common at several points along Licking River and on East and North forks of Triplet.

Sylvilagus floridanus mearnsii (Allen).—Mearns cottontail. This mammal is common throughout the area. During certain winters it does considerable damage to fruit trees by gnawing the bark. Hunters manage to obtain good bags during the open seasons.

Odocoileus virginianus virginianus (Boddaert).—Virginia deer. In early times deer were common throughout this section. The only record in recent years is a sight record on the C. C. C. trail over Clack Mountain in the summer of 1938.

INTRODUCED SPECIES

Mus musculus musculus Linnaeus.—House mouse. The house mouse is very common.

Rattus norvegicus (Erxleben).—Norway rat. This species is very abundant. It causes considerable damage to stored grains of the farmer and is also a nuisance in towns and villages.

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A PARASITOLOGICAL RECONNAISSANCE IN ALASKA WITH PARTICULAR REFERENCE TO VARYING HARES[1]

By Cornelius B. Philip

The present paper contains observations made during a field detail in June and July 1937, to various points in Alaska in connection with a survey for possible occurrence of Rocky Mountain spotted fever virus in the rabbit tick, *Haemaphysalis leporis-palustris*, in that territory.

Information of tick occurrence in Alaska is meager; however, the rabbit tick has been taken by several collectors both in Alaska and central British Columbia so that Olenev's (1934) distributional map needs considerable revision northward for that species, at least in western North America.

As this tick is a known carrier of Rocky Mountain spotted fever, emphasis in collecting was placed on the varying hare, *Lepus americanus macfarlani*. Opportunity thus was presented to make some incidental biological observations on this animal, as well as to obtain certain parasitological data on these and other potential tick hosts in the areas visited. The parasitological features of the trip were presented in Part II of this paper (Philip, 1938).

The available time for collecting in each locality was limited, and the best returns for time spent in hunting hares were found to be had along the roads at dusk and dawn, although in the more northern areas the season provided sufficient visibility for all-night hunting. Advantage was also taken in the Chitina area, of the ability of an old Indian to "call" nearby hares "to the gun" by a high-pitched squeak resulting from sucking in the inside of the curved index finger.

Invaluable assistance was rendered both in the field and in the laboratory by many persons to whom space does not permit personal acknowledgment. The writer is especially indebted to Messrs. Dufresne and Rhodes, and wardens Gallwas and White of the Alaska Game Commission, Mr. Jack Warwick of the Biological Survey, Mr. Otto Geist of the University of Alaska, Mr. Jay Williams of the Forestry Service, and Mr. D. G. Nichols of the American Museum of Natural History, for assistance in the collection of materials, and to Drs. E. R. Hall, E. E. Wehr, R. D. Lillie, G. E. Davis, Karl Jordan, and Messrs. Allen McIntosh, J. T. Lucker, Jr., W. L. Jellison, and Glen Kohls in the matter of various laboratory studies and identifications.

OBSERVATIONS ON VARYING HARES

In all, 172 hares were taken in the various localities. A marked preponderance of females over males was noted among the hares collected along

[1] Contribution from the Division of Infectious Diseases, National Institute of Health, Rocky Mountain Laboratory, Hamilton, Montana. Part of a paper read before the Indianapolis meeting of the American Society of Parasitologists, December 29, 1937.

the roads, regardless of locality. The reasons for this are not clear since the figures obviously are not in agreement with observed sex ratios of the varying hare.

Only 29 of the 172 were adult males; 46 were females carrying young, 68 were lactating females with more or less recently born litters, the remainder were barren females or immature animals of both sexes, most of them about fully grown. The number of fetuses per female of the above 46, varied from 3 to 7 with a mean of 4.9 (5 carried 7, 6–6, 16–5, 14–4, and 3–3). One was observed to be still pregnant July 23 at Chitina. Aldous (1937) has recorded an unusually late pregnancy the last of August in the race *phaeonotus* in Minnesota. The period of greatest fecundity among Alaskan hares would appear to be in late June and early July. MacFarlane (1905) made the interesting observation on hares in northern Canada that "a litter usually consists of 3 or 4; but when on the 'periodic' increase, females are known to have as many as 6, 8 and even 10 at a time and then gradually return to 3 and 4." This is not substantiated in Aldous' observations, whereas Mac Lulich wrote: "data on the rate of reproduction bear out the statements of other naturalists to the effect that the rate is decreased at the time of decrease in abundance of hares." In the Fairbanks area, where the greatest number of animals were taken per unit of sampling time (i.e., where the observed population was most dense), the mean number of fetuses in 33 pregnant females was 5.2, a little greater than the mean of 4.9 for the total 46 for the entire trip (the embryo frequency distribution for that area was 5 females with 7, 5 with 6, 15 with 5, 7 with 4, and 1 with 3). In the light of Mac Farlane's suggestion, it is of interest to note that all of the pregnant females with 7 and all but one with 6 were from the vicinity of Fairbanks. Aldous' figures for 266 pregnant females of the Minnesota subspecies examined over portions of 4 years included only 2 with 7 and 1 with 6 embryos.

Data on the various collections are presented in Table I. Accurate data were, of course, not obtained on the question of number of litters per season; but consideration of conditions of lactation, pregnancy, and size of observed young in relation to dates, suggests that, in Alaska, there are normally two.

Comments on hare abundance.—As a result of discussing previous increases and declines in the numbers of these animals with older, local residents who had obvious reasons to be familiar with these cycles, such as trappers, and dog-owners who use hares for food for their dogs, certain observations are suggested, viz., that the "die-off" does not necessarily occur simultaneously over the whole territory, but different localities are often affected in different years, and conversely that the subsequent rates of increase vary; also that the different peaks of abundance in any given area do not always reach the same population density.

In the various localities visited, reports of the year of last "die-off" varied from 1926 to 1932 (see also Gasser, 1935). In 1937, it seemed apparent in

most areas that the hare populations were approaching, or had reached, another peak. In view of present abundance, this is not in accord with the popular ideas of a seven-year cycle. Elton's reports indicate 10 years as the interval between peaks in Canadian hare populations and it is of interest to note that, quoting reports of Alaskan observers for 1935, he stated (1936): "Previous records and some fur statistics recently obtained show that Alaska has a similar rabbit cycle to Canada, and it seems certain that this or the

TABLE I. DATA ON VARYING HARES TAKEN IN ALASKA

BIOLOGICAL DATA								NUMBER HARES WITH PARASITES				
Locality	Dates	No. hares	Sex			No. ♀ with young		Larval tape-worms	Adult tape-worms	Nematodes	Rabbit ticks	Rabbit fleas
			Male	Female	Imm.	Unborn	Born*					
	June											
Lake Bennett	9	1		1			1					
Seward	12–21	22	5	13	4	2	9	5	5		7	
Mills Creek	30	4		1	3	1						
	July											
Anchorage	2	6		4	2	4		3				
Fairbanks	6–8	36	7	28	1	19	5	5	4		23 ⁂	
do	12–15	34	7	22	5	14	7	4	1		17 ⁂	
Circle Hot Springs	10	5	1	4		2	2					1
Circle	10	1	1									1
Rapids	15–19	31	4	25	2	2	23	7	4			2
Gulkana	21–22	16	1	11	4	1	10	2	1	1		4
Chitina	23–24	14	3	11		1	9	3	1			14
Cordova	28	2		2			2					
Totals		172	29	122	21	46	68	29	16	1	47	22

⁂ Excluding hares from other than the restricted "College farm-loop road" area, 39 of 46 carried light to moderate tick infestations, while there was one tick on only one of the remaining 31 from all other Fairbanks areas.

* Mostly recently born as indicated by lactation and often by condition of uterus; apparently barren females are excluded from this column.

next winter will have witnessed the beginning of decline." His records show considerable lag in the decline of the northwestern populations in relation to those noted farther eastward, and this appears to have been especially true of those in Alaska, since the predicted decline had not yet affected the Seward and Fairbanks areas from which he had reports. Notable scarcity was observed by the writer only at Mills Creek in central Kenai, certain areas along the Steese Highway, particularly near Circle, Miller House and

Mastodon Creek, the vicinity of Cordova, and at Lake Bennett, Yukon Territory.

Periodic decimation by disease is one popular explanation of these rhythms.[2] Without elaborating on the merits of this or other suggested factors, I may say that scarcity and rather localized distribution of fleas and ticks make it difficult to understand how any disease carried by these arthropods could be a factor in a general "die-off" of hares in the near future in south central Alaska, at least without an almost explosive increase and spread of the parasites. On the other hand, it is of interest that ticks taken from a hare with suspiciously enlarged spleen in the Fairbanks area, as well as pooled ticks from other hares, were found to be harboring *Bacterium tularense* of considerable virulence for laboratory rabbits and guinea pigs (Philip and Parker, 1938). This pathogen could at least be a contributing factor to hare decimation, as it has been observed to be among rabbit populations in the United States (Philip, Jellison and Wilkins, 1935, among others) under conditions of abundant tick infestation. Observations of Mr. Warwick in the Fairbanks area indicate that some decimation was occurring in a very restricted environment both before and after the writer's visit.

However, present information suggests that tularemia is spread among rodents largely by ectoparasites. Although laboratory experience with guinea pigs has shown that contact infections may occur, they seem a remote possibility in nature. Extensive spread by either means would not appear easy of accomplishment under the conditions observed in the Fairbanks area in which the observed localization of the rabbit tick suggested little intermingling even between adjacent hare communities.

Nor is it evident how biting flies could act as vectors except in a localized capacity. The season was undoubtedly late biologically, and only one deerfly (*Chrysops furcata*) was observed during the entire trip in spite of constant vigilance, while larger horseflies (*Tabanus affinis, T. septentrionalis*) were observed to be numerous only at Deadwood and about domestic stock near Gulkana, and less so at Fairbanks. However, that several kinds of biting flies do become numerous, at least in some localities, is amply indicated by the lists of several collectors.

Furthermore, as regards tularemia, mosquitoes (Philip, Davis and Parker, 1933) and tabanids of several species (Francis and Mayne, 1922, and Philip and Jellison, unpublished) may act in its mechanical transmission experimentally, although none of these insects appears to be very efficient even in little-delayed transfer.

It is of interest to note that, since this report was prepared, the first (2) cases of tularaemia in persons also have been reported from Alaska in July, 1938. (Publ. Health Repts., Oct. 21, 1938).

[2] The most recent is "shock disease" reported by Green and Larson (1938, Amer. Jour. Hyg., vol. 28, pp. 190–212) since this manuscript was prepared.

SUMMARY AND CONCLUSIONS

1. A total of 172 varying hares were taken at various places in south-central Alaska (northward to Circle on the Yukon River) and at Lake Bennett, Canada, during the period June 9 to July 28, 1937.

2. Of the total, only 29 were adult males, 46 were pregnant females with 3 to 7 fetuses (mean 4.9), 68 were lactating females with more or less recently-born litters, the remainder were barren females or immature hares of both sexes. The period of greatest fecundity appeared to be in late June and early July.

3. Greatest density in population, judged by numbers taken per unit of sampling time, appeared to be in the vicinity of Fairbanks.

4. Tularemia was recovered from rabbit ticks in a very limited area near Fairbanks. The general scarcity of rabbit ticks and fleas makes it difficult to see how tularemia could soon be a factor, if at all, in extensive decimation of hares, although there appeared to be near-peak abundance of these animals in most of the areas visited.

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REVIEW OF THE POCKET GOPHERS OF THE GENUS PLATYGEOMYS

By E. A. Goldman

More than 40 years have passed since the pocket gophers of the Mexican genus *Platygeomys* were revised by Merriam (North Amer. Fauna, no. 8, pp. 162–171, Jan. 31, 1895). Two forms, *Platygeomys neglectus* (Proc. Biol. Soc. Washington, vol. 15, p. 68, March 22, 1902), and *Platygeomys tylorhinus angustirostris* (*op. cit.*, vol. 16, p. 81, May 29, 1903) were later described by him, but there has been no subsequent consideration of the genus as a whole.

The extraordinary development of the pocket gophers, family Geomyidae, within a very limited area near the southern end of the Mexican tableland was pointed out by Merriam (1895). In that region representatives of seven genera are closely grouped in the highly diversified territory culminating in the highest mountains of the continent south of Alaska. The ranges of the various genera and component species are more or less interrupted or intricately interwoven, but apparently remain distinct. Habitat relations are imperfectly known, but there is some evidence that island-like populations of one genus may be completely isolated by territory occupied by another.

The known range of the genus *Platygeomys* is restricted to a belt that, though very narrow from north to south, extends from Colima east through southern Jalisco, Michoacan and the highest part of the tableland region to northern Queretaro, western Hidalgo and the State of Mexico. Within this area different species vary much in habitat within a short distance, as from the palm groves at 1,700 feet altitude in the Tropical Zone in Colima to the fir and spruce clad slopes at 10,000 to 11,000 feet in the Canadian Zone on the Sierra Nevada de Colima, Jalisco, localities less than 100 miles apart in a direct line.

The species of *Platygeomys* appear to consist of populations of very local occurrence, but where found the individuals are apt to be numerous. While distribution is discontinuous the colonies often occur in close proximity to those of other genera. On the north slope of the Volcano of Toluca, Mexico, we found *Platygeomys planiceps* at 8,600 feet altitude, and 1,000 feet higher on the same side of the mountain *Thomomys umbrinus tolucae* was collected. The mountains near Patzcuaro, along the southern shore of Lake Patzcuaro, Michoacan, are occupied at 7,000 feet by *Platygeomys gymnurus imparilis*, but at 8,000 feet nearby this form has given way to *Zygogeomys trichopus*. The north slope of the Sierra Nevada de Colima, Jalisco, is inhabited at 6,500 feet by *Platygeomys gymnurus inclarus* and *Pappogeomys bulleri*. While these representatives of two genera, the former very large and the latter quite small, appear to be practically in contact it is probable that they do not share the same local terrain.

The generic characters of *Platygeomys* have been well set forth by Merriam

and need not be repeated here. The extraordinary flattening of the cranium is, alone, a convenient distinguishing character. The genus *Platygeomys* is one of the most highly specialized of the family. It includes several widely divergent forms that seem to warrant full specific rank. Specimens from nearly every locality present some slight peculiarities, but their agreement in general cranial pattern suggests that they should, at least in some cases, be treated as geographic races.

The names of colors used in descriptions in quotation marks are from Ridgway's Color Standards and Nomenclature, 1912.

LIST OF SPECIES AND SUBSPECIES

Platygeomys gymnurus Merriam

[References under subspecies]

Distribution.—Interior plains and high mountains of southern Jalisco and east to the mountains of central Michoacan.

Platygeomys gymnurus gymnurus Merriam

Platygeomys gymnurus Merriam, North Amer. Fauna, no. 8, p. 164, Jan. 31, 1895. Type from Zapotlan, Jalisco, Mexico (altitude 4,000 feet).

Distribution.—Known only from the type locality in the interior basin near Lake Zapotlan, southern Jalisco.

Remarks.—Typical *gymnurus* is distinguished by the largest size, and the most massive cranial development of any of the known forms of the genus. The upper parts are "warm sepia" in color in the fresh coat, fading to near "cinnamon" in worn pelage.

Platygeomys gymnurus inclarus, subsp. nov.

Type.—From north slope Sierra Nevada de Colima, Jalisco, Mexico (altitude 10,000 feet), No. 33582/45617, ♀ young, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, April 22, 1892. Original number 2532.

Distribution.—Known only from the Sierra Nevada de Colima, southern Jalisco (altitude 5,000 to 10,000 feet).

General characters.—A large, very dark-colored subspecies, closely allied to *Platygeomys gymnurus gymnurus* of the adjoining interior basin, near Lake Zapotlan (altitude 4,000 feet), southern Jalisco, but pelage longer and denser and differing strongly from the typical form in its "fuscous" or nearly black instead of "cinnamon" upper parts; cranial characters about the same. Approaching the tropical species, *Platygeomys fumosus*, of Colima in color, but much larger, pelage much longer and denser; skull more angular and massive.

Color.—*Type* (in pelage of young): Upper parts, including forearms, flanks and thighs nearly uniform glossy black, a few grayish guard hairs projecting beyond general pelage along flanks and on rump; under parts near "mouse gray", very thinly and inconspicuously overlaid with "pinkish buff"; feet dark brown, a few whitish bristles on toes; tail thinly clothed with fine, short, brownish hairs. An adult female from 6,500 feet is near "fuscous" above and buffy gray below.

Skull.—About as in typical *gymnurus*. Compared with that of *fumosus* the skull is much larger, more angular and massive; sagittal and lambdoid crests higher, more trenchant; mastoid processes of squamosals much heavier and projecting laterally more prominently behind deeper concavities of the squamosal border over auditory meatus;

zygomata heavier, the external angles more developed; jugal much more expanded anteriorly at insertion in maxilla; dentition similar.

Measurements.—Type (young): Total length, 256 mm; tail, 82; hind foot, 43. An adult female from 6,500 feet altitude, Sierra Nevada de Colima: 318; 78; 49. *Skull* (type [young ♀] and adult female above, respectively): Greatest length (median line, occiput to front of incisors), 44.8, 59.8; zygomatic breadth, 29.5, 42.1; width across squamosals (over mastoids), 28, 42.3; interorbital constriction, 8, 9.7; maxillary toothrow, 10.3, 13.3; width of upper incisors (alveoli, measured from behind), 6.5, 9.7.

Remarks.—P. g. inclarus is a dark high mountain form requiring close comparison only with typical *gymnurus*.

Specimens examined.—Three, from the Sierra Nevada de Colima, Jalisco, at 5,000, 6,500, and 10,000 feet altitude, respectively.

Platygeomys gymnurus imparilis, subsp. nov.

Type.—From Patzcuaro, Michoacan, Mexico (altitude 7,000 feet). No. 34918/47183, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, July 23, 1892. Original number 2918.

Distribution.—Known only from the type locality on the lower slope of the mountains near the southern shore of Lake Patzcuaro, Michoacan.

General characters.—A large race, similar to *Platygeomys gymnurus gymnurus* of the interior basin near Lake Zapotlan, southern Jalisco, but general color darker brown, black auricular areas larger, and hind feet more extensively marked with white; skull narrower, less flattened and massive. Similar in general to *Platygeomys tylorhinus* of Hidalgo, but larger; color darker, less rufescent; black auricular areas larger; skull with more widely spreading zygomata, the outer angles more acute, and differing in other details. Nearest geographically to *Platygeomys angustirostris* of the upper slopes (10,000 feet) of Mount Patamban, Michoacan, but much larger; color darker; skull broader and heavier.

Color.—Type (unworn pelage): Ground color of upper parts from top of head over back and rump near "mikado brown" or "russet", finely and inconspicuously mixed with black, becoming clearer "mikado brown" along sides, forearms and thighs; forehead, middle of face and muzzle near "mars brown"; under parts "mouse gray" thinly overlaid with "wood brown"; auricular patches, encircling and extending about an inch behind ears, black; fore feet brownish, except a few white bristles on toes, and the tufts of stiff whitish bristles at posterior edge of soles; hind feet brownish, irregularly marked with white; tail practically naked, a few fine, inconspicuous, brownish hairs near base.

Skull.—Similar to that of *gymnurus*, but narrower, less flattened and massive; squamosals less extended as lateral shelves over glenoid fossae; rostrum flatter; nasals usually broader, less wedge-shaped posteriorly, and premaxillae correspondingly reduced in width; maxillary arm of zygoma narrower; jugal broader anteriorly, encroaching farther on maxilla, the anterior margin more squarely truncate, instead of rounded as in *gymnurus*; lambdoid crest less deeply sinuous in adult males, the median concavity less pronounced, as viewed from above; dentition lighter. Compared with that of *tylorhinus* the skull is larger, broader and more flattened, with more widely spreading zygomata; lambdoid crest less deeply sinuous; zygomata with external angles more acute (more rounded in *tylorhinus*); jugal broader anteriorly, at insertion in maxilla, the anterior margin truncate instead of rounded; upper incisors usually curving nearly directly downward from ends of nasals, instead of projecting anteriorly beyond nasals as in *tylorhinus*. Skull much larger, broader, and heavier than in *angustirostris*.

Measurements.—Type: Total length, 370 mm; tail, 108; hind foot, 50. An adult male topotype: 344; 98; 52. Two adult female topotypes, respectively: 335, 328; 95, 88; 46, 45. *Skull* (type [♂] and an adult female topotype, respectively): Greatest length

(median line, occiput to front of incisors), 65.7, 62.1; occipitonasal length, 65.7, 59.3; zygomatic breadth, 46, 41.8; width across squamosals (over mastoids), 46, 44.1; interorbital constriction, 9.1, 8.6; length of nasals, 24, 20.7; maxillary toothrow, 13.4, 12; width of upper incisors (alveoli, measured from behind), 10.7, 9.

Remarks.—*P. g. imparilis* is a well-marked race, but approaches *gymnurus* in cranial characters, especially the form of the jugal and the deflection of the upper incisors, that suggest intergradation. It requires no close comparison with its near geographic neighbor *angustirostris*.

Specimens examined.—Five, all from the type locality.

Platygeomys fumosus Merriam

Platygeomys fumosus Merriam, North Amer. Fauna, no. 8, p. 170, Jan. 31, 1895. Type from three miles west of city of Colima, Colima, Mexico (altitude 1,700 feet).

Distribution.—Plains of Colima, Colima (altitude 1,500 to 2,000 feet).

Remarks.—*Platygeomys fumosus* is characterized by small size and dark coloration ranging from "cinnamon drab" to "fuscous". Owing to tropical habitat the pelage is thin, the under parts very scantily covered. The skull is of the *gymnurus* type, with strongly decurved upper incisors, but differs strongly in small size and lack of angularity.

Platygeomys angustirostris Merriam

Platygeomys tylorhinus angustirostris Merriam, Proc. Biol. Soc. Washington, vol. 16, p. 81, May 29, 1903. Type from Mount Patamban, Michoacan, Mexico (altitude 10,000 feet).

Distribution.—Known only from the type locality.

Remarks.—This form, based on a single specimen, and originally described as a subspecies of *tylorhinus*, differs so markedly from that species in the slightly forward projection of the upper incisors, and in other cranial details, that it seems best to regard it as distinct.

Platygeomys varius sp. nov.

Type.—From Uruapan, Michoacan, Mexico (altitude about 6,000 feet). No. 126144, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, March 8, 1903. Original number 16105.

Distribution.—Known only from the type locality.

General characters.—A small species, similar in general to *Platygeomys angustirostris* of Mount Patamban (10,000 feet), Michoacan, but smaller; ground color of upper parts near "mikado brown" instead of between "cinnamon" and "orange-cinnamon", and more extensively mixed with black; skull smaller, with relatively narrower braincase, and differing in detail. Resembling *Platygeomys gymnurus imparilis* in color, but black auricular patches much smaller, less extended posteriorly; skull characters, especially the form of the jugal, distinctive.

Color.—*Type* (unworn pelage): Ground color of upper parts from top of head over back and rump near "mikado brown" or "russet", finely mixed with black, becoming near "cinnamon-brown" along flanks, forearms and thighs; forehead blackish; muzzle dark brown; under parts thinly haired, the under color "light mouse gray", thinly overlaid with "vinaceous buff"; auricular patches deep black, but small; feet brownish, a few whitish or grayish bristles on toes; tail nearly naked, a few short brownish hairs on basal half of upper side.

Skull.—Similar in general to that of *angustirostris*, but smaller; cranium narrower, less flattened posteriorly, the squamosals less extended laterally; rostrum broader; nasals broader and flatter; premaxillae broader, but similarly tapering and pointed posteriorly; jugal more slender, narrower and more evenly rounded anteriorly where

inserted in maxilla; basioccipital broader; mastoid and auditory bullae much smaller, less inflated; molars about the same; incisors narrower. Compared with that of *imparilis* the skull is much smaller; braincase narrower, the squamosals less extended laterally; premaxillae more tapering and pointed posteriorly; jugal narrower, more evenly rounded anteriorly, instead of squarely truncate and expanded upward at point of union with maxilla; basioccipital relatively broader; mastoid and auditory bullae much smaller, less inflated, the auditory bullae not bulging below level of basioccipital as in *imparilis*; dentition similar, front of upper incisors curving downward in anterior plane of nasals.

Measurements.—Type: Total length, 305 mm; tail, 94; hind foot, 44. *Skull* (type): Greatest length (median line, occiput to front of incisors) 50.2; occipitonasal length, 50.2; zygomatic breadth, 37.6; width across squamosals (over mastoids), 36.3; interorbital constriction, 8.5; length of nasals, 20; maxillary toothrow, 12.2; width of upper incisors (alveoli, measured from behind), 9.

Remarks.—P. varius is based on a single specimen which presents cranial characters apparently beyond the range of individual variation in the related forms. It agrees most closely with the geographic neighbor, *P. angustirostris*, which is also known from a single specimen, but the adult male of *varius* is smaller than the adult female of *angustirostris*, and cranial features assumed to be distinctive are pointed out. Relationship to *P. fumosus* of Colima is remote.

Platygeomys tylorhinus Merriam

Platygeomys tylorhinus Merriam, North Amer. Fauna, no. 8, p. 167, Jan. 31, 1895. Type from Tula, Hidalgo, Mexico (altitude 6,800 feet).

Distribution.—Known only from the type locality, and from Marques (8,000 feet), in the mountains of southwestern Hidalgo.

Remarks.—A rather large species, similar to *planiceps* of the Volcan de Toluca, Mexico, with which it may prove to intergrade. The color of the upper parts is near "mikado brown" in both. The skull is very similar to that of *planiceps* in general contour, but the braincase is less flattened; lambdoid crest more deeply sinuous; zygomata heavier; jugal decidedly broader anteriorly; nasals shorter, leaving the frontals more prolonged along the median line anteriorly; upper incisors procumbent as in *planiceps*. Compared with *gymnurus* of Jalisco, *tylorhinus* is similar in color but strongly contrasted in cranial characters: Skull smaller, less flattened, and much less massive; upper incisors projecting forward beyond nasals (strongly decurved in *gymnurus*).

Platygeomys planiceps Merriam

Platygeomys planiceps Merriam, North Amer. Fauna, No. 8, p. 168, Jan. 31, 1895. Type from north slope Volcan de Toluca, State of Mexico, Mexico (altitude 9,000 feet).

Distribution.—Known only from the Volcan de Toluca.

Remarks.—A rather large species, agreeing closely in some of the more essential characters with *tylorhinus* of Hidalgo, but differing in apparently important cranial details: Braincase more flattened; lambdoid crest straighter, less deeply sinuous; zygomata slenderer; jugal very narrow, not decidedly broadened anteriorly as in *tylorhinus*; nasals longer, encroaching farther on frontals along median line; upper incisors procumbent as in *tylorhinus*.

Platygeomys zinseri, sp. nov.

Type.—From Lagos, Jalisco, Mexico (altitude 6,150 feet). No. 78971, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, June 29, 1896. Original number 9718.

Distribution.—Elevated plain in the vicinity of the type locality, and east to San Diego de la Union, northern Guanajuato.

General characters.—Similar in general to *Platygeomys tylorhinus* of Hidalgo, but larger, somewhat less rufescent, and cranial details, especially the more widely and squarely spreading zygomata quite distinctive. Approaching *Platygeomys gymnurus gymnurus* of the interior basin near Lake Zapotlan, southern Jalisco, in general dimensions, but less robust; tail longer; under parts darker and uniformly browner, lacking the distinctly grayish throat and chin of *gymnurus*; skull less flattened and lighter in structure.

Color.—Type (acquiring fresh pelage): Upper parts from top of head over back and rump between "mikado brown" and "cinnamon", the black-tipped hairs almost imperceptible, becoming lighter and clearer "cinnamon" along sides, forearms and thighs; forehead, middle of face and muzzle dark brownish; under parts between "cinnamon", and "cinnamon buff" thinly overlying the pale plumbeous basal color; auricular patches blackish; feet thinly clothed with brownish hairs, except a few grayish hairs on toes of left hind foot; tail nearly naked, a few brownish hairs near tip. *Young* (in first pelage): Considerably darker than adults, the upper parts mixed with black.

Skull.—Similar in general to that of *tylorhinus*, but larger, more angular; nasals longer, encroaching farther on frontals along median line posteriorly; zygomata more widely spreading anteriorly, the external angles much broader and heavier; jugal and zygomatic arm of squamosal heavier; lambdoid crest higher, more prominent; auditory bullae more flattened, as viewed from below (more rounded and tending to bulge below level of supraoccipital in *tylorhinus*); dentition similar. Nearly as large as that of *gymnurus*; similarly angular, but of lighter proportions; braincase narrower, the squamosals less extended as lateral shelves; rostrum decidedly narrower, the narrowness mainly in the premaxillae; lateral borders of premaxillae more strongly upturned for muscular attachment in front of zygomata; zygomata more slender, the maxillary arms more convex along anterior margins, very slender near lachrymals, but broadening to external angles which are as fully expanded and as heavy as in *gymnurus*; frontal region narrower, more deeply excavated along median line; mastoids much smaller, because of their less lateral extent; dentition much lighter; upper incisors projecting anteriorly beyond nasals (upper incisors more strongly recurved, not projecting anteriorly beyond nasals as in *gymnurus*).

Measurements.—Type; Total length, 358 mm; tail, 115; hind foot, 45.5. Five adult female topotypes: 322 (315-330); 104 (99-106); 44.5 (44-45.5). *Skull* (type [♂] and an adult female topotype, respectively): Greatest length (median line, occiput to front of incisors), 65.1, 59.4; occipitonasal length, 63.1, 58.2; zygomatic breadth, 48.5, 43.2; width across squamosals (over mastoids), 42.7, 41.3; interorbital constriction, 9.3, 8.8; length of nasals, 23, 21.3; maxillary toothrow (alveoli), 13.3, 12.5; width of upper incisors (alveoli, measured from behind), 9.2, 8.7.

Remarks.—Like some of the other representatives of the genus, *Platygeomys zinseri* seems to stand somewhat apart. The skull is rather light in structure, but large and angular with ample provision for broad muscular attachment.

This remarkable rodent is dedicated to Señor Juan Zinser, Chief of the Game Service of the Department of Forestry, Game and Fish of Mexico, in recognition of his distinguished services in fostering the protection and better management of wildlife.

Specimens examined.—Total number, 11, as follows:

Jalisco: Lagos (type locality), 10.

Guanajuato: San Diego de la Union, 1.

Platygeomys neglectus Merriam

Platygeomys neglectus Merriam, Proc. Biol. Soc. Washington, vol. 15, p. 68, Mar. 22, 1902. Type from Cerro de la Calentura, about 8 miles northwest of Pinal de Amoles, Queretaro, Mexico (altitude 9,500 feet).

Distribution.—Known only from the upper slopes of the Cerro de la Calentura, Queretaro.

Remarks.—*P. neglectus* stands somewhat apart as the smallest of the known species of the genus. In color it is not very unlike *planiceps* of the Volcan de Toluca, Mexico, and the skull is somewhat similar in form, slenderness of proportions, and anterior projection of upper incisors beyond nasals. The skull, however, is more smoothly rounded, lacking the angularity of *planiceps*; zygomata weakly developed, more evenly bowed outward, the external angles less prominent, and sides more nearly parallel; lambdoid crest lower, less upturned; interorbital region relatively broader and flatter, the sides less upturned as supraorbital ridges; dentition much lighter.

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THE POCKET GOPHERS OF THE GENUS PAPPOGEOMYS

By E. A. Goldman

The genus *Pappogeomys* was described by Merriam in his 'Monographic Revision of the Pocket Gophers,' exclusive of the species of *Thomomys* (North Amer. Fauna, no. 8, pp. 145–149, Jan. 31, 1895). The only specimens available to him were six from the Sierra Nevada de Colima, Jalisco, Mexico, on which he had based *Geomys nelsoni* (Proc. Biol. Soc. Washington, vol. 7, p. 164, Sept. 29, 1892), and one described as *Pappogeomys albinasus* ('95, p. 149). The only other known specimen was the type of *Geomys bulleri* Thomas (Ann. Mag. Nat. Hist., ser. 6, vol. 10, p. 196, Aug., 1892) in the British Museum from near Talpa, Sierra de Mascota, Jalisco. The description of *bulleri* was published about a month prior to that of *nelsoni*, and as the two were from localities not very far apart, Merriam, assuming that they were the same, placed the latter in the synonymy of the former suggesting, however, that *nelsoni* might prove subspecifically separable.

In the spring of 1897 E. W. Nelson and the writer revisited the state of Jalisco, and worked northward into the present state of Nayarit. Twenty-five specimens of *Pappogeomys* were obtained, a few from various localities at from 3,800 to 6,500 feet altitude, including five from at or very near the type locality of *bulleri*. This additional material has now been critically examined for the first time.

The genus *Pappogeomys* is similar to *Geomys* in general appearance, especially in the small size (contrasted with other Mexican genera), and the strongly developed claws on the fore feet (contrasted with the weaker development in *Thomomys*), but the upper incisors are unisulcate, without a trace of the secondary sulcus present along the inner edges in *Geomys*. The mammae consist of a pectoral pair and two inguinal pairs, the total number six; other characters described in detail by Merriam need not be dwelt upon here. The genus appears to include a single species which subdivides into several closely allied geographic races. The occurrence of

Pappogeomys is in more or less isolated colonies in regions also inhabited by pocket gophers of other genera.

Colors given in quotation marks are from Ridgway, "Color Standards and Nomenclature," 1912.

Pappogeomys bulleri (Thomas)

[References under subspecies]

Distribution.—Mountain slopes, tableland and coastal region from southern Jalisco north to southern Nayarit.

Pappogeomys bulleri bulleri (Thomas)

Geomys bulleri Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 10, p. 196, August, 1892. Type from near Talpa, west slope of Sierra de Mascota, Jalisco.

Distribution.—Lower slopes of mountains in western Jalisco. The altitude of the type locality was originally given as 8,500 feet, but this was certainly an error as the Sierra de Mascota reaches only about 6,000 feet. Specimens were obtained by us at 4,500 to 5,000 feet on the Sierra de Mascota between Talpa and the town of Mascota, and it seems probable that the type came from the same vicinity.

Remarks.—The color of the upper parts varies from "cinnamon" to near "orange-cinnamon." Specimens from each locality appear to differ in minor cranial details and to some extent in color, and it is not improbable that larger series of specimens and more complete knowledge of distribution will render necessary the segregation of additional forms.

Pappogeomys bulleri nelsoni (Merriam)

Geomys nelsoni Merriam, Proc. Biol. Soc. Washington, vol. 7, p. 164, September 29, 1892. Type from north slope Sierra Nevada de Colima, Jalisco (altitude 6,500 feet).

Pappogeomys nelsoni Merriam, North Amer. Fauna no. 8, p. 258, 1895.

Distribution.—Known only from the type locality, where it occurs in close proximity to *Platygeomys gymnurus*, but the two probably do not share the same local terrain.

Remarks.—As already pointed out this form was placed in synonymy by Merriam, but in its "orange-cinnamon" coloration it is somewhat darker than usual in *bulleri*. The skull is more elongated than in *bulleri*, with zygomata less widely spreading anteriorly, the sides more nearly parallel; nasals longer and narrower.

Pappogeomys bulleri albinasus Merriam

Pappogeomys albinasus Merriam, North Amer. Fauna no. 8, p. 149, January 31, 1895. Type from Atemajac, a suburb of Guadalajara, Jalisco.

Distribution.—Definitely known only from the type locality, but burrows seen along the railroad a few miles west of Guadalajara were probably of this animal.

Remarks.—The characters presented by the type of *albinasus*, the only known specimen of this form, cannot be regarded as of more than subspecific value. The skull is relatively large, with a broad rostrum, broad but short nasals, and relatively short maxillary toothrow.

Pappogeomys bulleri nayaritensis, subsp. nov.

Type.—From Jalisco, about 10 miles south of Tepic, Nayarit, Mexico (altitude 5,000 feet). No. 88124, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, April 10, 1897. Original number 10886.

Distribution.—Known only from the type locality, on the mountain ridge between the valleys of Compostela and Tepic, Nayarit.

General characters.—Closely allied to *P. albinasus* of Atemajac, near Guadalajara, Jalisco; size similar; color more rufescent, the upper parts shading toward "orange-cinnamon", instead of nearer "cinnamon"; feet, chin and forearms irregularly, but more extensively blotched with white; skull differing in detail, especially the more slender rostrum and longer maxillary toothrow. Similar in general to *P. bulleri*, of the Sierra de Mascota, near Talpa, Jalisco, but decidedly larger. Somewhat larger than *nelsoni* of the Sierra Nevada de Colima, Jalisco; color less rufescent, the upper parts shading toward "cinnamon" instead of clearer "orange-cinnamon"; differential cranial details include zygomata less squarely spreading anteriorly.

Color.—Type (unworn pelage): Upper parts from top of head to rump between "cinnamon" and "orange-cinnamon" very finely and inconspicuously mixed with black; under parts thinly overlaid with the same color, the "mouse gray" under color showing through; chin, lining of cheek pouches, small areas on under sides of wrists and bordering nasal pad white; ears narrowly encircled with black; fore feet brownish, except a few whitish bristles on toes; hind feet clothed with short whitish hairs; tail naked, the dry skin brownish all around.

Skull.—Similar in size and general proportions to that of *albinasus*; rostrum narrower, the reduction mainly in width of premaxillae; parietals longer; zygomata about the same; interorbital region broader; maxillary toothrow longer. Compared with that of *bulleri* the skull is similar, but decidedly larger. Compared with that of *nelsoni*: Size larger; nasals relatively shorter and broader; zygomata usually less squarely spreading anteriorly, the anterior border of the maxillary arms sloping slightly backward, instead of directed outward at more nearly right angles to axis of skull; mastoids rounded above, instead of somewhat truncated; dentition similar.

Measurements.—Type: Total length, 253 mm; tail, 84; hind foot, 35. An adult male topotype: 237; 82; 33. Average of four adult female topotypes: 237 (230–247); 81 (80–82); 33.2 (32.5–35). *Skull* (type, male, and an adult female topotype, respectively): Occipitonasal length, 44, 40.7; zygomatic breadth, 26.6, 25.2; width across squamosals (over mastoids), 27.2, 23.4; interorbital constriction, 8, 8; length of nasals, 16.2, 14.2; maxillary toothrow (alveoli), 10.2, 9.7; width of upper incisors (cutting edge), 4.8, 4.4.

Remarks.—Pappogeomys b. nayaritensis differs only in minor details from the other forms of the genus, but seems to warrant recognition as a large northern geographic race.

Specimens examined.—Eight, all from the type locality.

Pappogeomys bulleri flammeus, subsp. nov.

Type.—From Milpillas, 5 miles southwest of San Sebastian, northwestern Jalisco, Mexico (altitude 3,800 feet). No. 88117, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, March 15, 1897. Original number 10716.

Distribution.—Known only from the type locality.

General characters.—A large, rich reddish subspecies, similar in general to typical *bulleri*, but larger; color darker, more vivid; cranium less flattened. Somewhat similar to *nayaritensis*, but smaller; color more reddish; skull more slender and differing in detail.

Color.—Type (worn pelage): Upper parts nearly uniform rich "orange-cinnamon", paling gradually along sides to "cinnamon" on the under parts; a white patch covers chin and throat; nasal pad bordered with white; ears brownish; forelimbs like under parts; hind feet brownish to toes, which are white.

Skull.—Similar in general to that of *bulleri*, but larger; braincase more highly arched; zygomata in adult male more widely spreading, the maxillary arches standing out at nearly right angles to axis of skull; dentition heavier. Compared with *nayaritensis* the skull is smaller and slenderer; braincase relatively narrower; frontal region more depressed; squamosals narrower, less projecting as lateral shelves over glenoid fossae; zygomata narrower posteriorly, more divergent anteriorly, the maxillary arches in adult male wider and standing out more nearly at right angles to axis of skull; jugal heavier, more angular; dentition similar.

Measurements.—Type: Total length, 240 mm; tail vertebrae, 80; hind foot, 31. An adult female topotype: 212; 71; 28. *Skull* (type, male, and an adult female topotype, respectively): Occipitonasal length, 41.4, 39; zygomatic breadth, 27.8, 22.3; width across squamosals (over mastoids), 24.8, 20.7; interorbital constriction, 7.7, 7.4; length of nasals, 15.9, 13.4; maxillary toothrow (alveoli), 9.3, 8.9; width of upper incisors (cutting edge), 4.7, 4.3.

Remarks.—In the clear, intense reddish tone of the upper parts this subspecies surpasses *nelsoni*, which is also vividly colored. The two do not, however, require very close comparison in cranial details.

Specimens examined.—Four, from the type locality.

Pappogeomys bulleri lagunensis, subsp. nov.

Type.—From La Laguna, Sierra de Juanacatlan, northwestern Jalisco, Mexico (altitude 6,500 feet). No. 88121, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, March 24, 1897. Original number 10802.

Distribution.—Known only from the type locality.

General characters.—A high mountain subspecies, bearing a general resemblance to typical *bulleri* of the neighboring Sierra de Mascota, but larger; color similar, but face less extensively marked with white; skull more massive. Similar in size to *flammeus* of lower elevations 15 or 20 miles northwest, but color duller, lacking the rich reddish tone of the latter; skull differing in detail.

Color (acquiring fresh pelage): Upper parts near "cinnamon", purest along sides, the top of head and back finely and inconspicuously mixed with black; under parts and forearms paler, shading toward "cinnamon-buff"; a white patch on chin and throat; nasal pad narrowly bordered with white; ears narrowly encircled with black; feet dull whitish; tail very thinly and indistinctly clothed with short whitish hairs, the yellowish color of skin predominant. A breeding female topotype is darker, the upper parts more extensively mixed with black.

Skull.—Similar in general to that of *bulleri*, but larger and heavier; braincase broader; nasals and ascending branches of premaxillae broader, broadening the rostrum as a whole; auditory bullae less inflated and projecting below level of basioccipital; molariform teeth heavier. Similar in size to that of *flammeus*, but braincase lower and flatter; zygomata in adult male less widely and squarely spreading anteriorly; nasals shorter; ascending branches of premaxillae broader; auditory bullae less inflated and projecting below level of basioccipital; dentition about the same.

Measurements.—Type: Total length, 222 mm; tail vertebrae, 76; hind foot, 32. An adult female topotype: 215; 75; 30. *Skull* (type, male, and an adult female topotype, respectively): Occipitonasal length, 41, 37.3; zygomatic breadth, 25.1, 22.9; width across squamosals (over mastoids), 23.4, 21.1; interorbital constriction, 7.7, 7; length of nasals, 13.8, 12.8; maxillary toothrow (alveoli), 9, 8.6; width of upper incisors (cutting edge), 4.1, 3.9.

Remarks.—The high mountain range of this subspecies is only a few miles from the

areas inhabited by *bulleri* and *flammeus*, but is in a region varying greatly in local topography. The combination of differential characters presented is probably due largely to the existence of partially effective barriers favoring isolation.

Specimens examined.—Two, from the type locality.

Pappogeomys bulleri amecensis, subsp. nov.

Type.—From mountains near Ameca, Jalisco, Mexico (altitude 6,500 feet). No. 82189, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, February 20, 1897. Original number 10554.

Distribution.—Known only from the region of the type locality in the upper part of the valley of the Rio de Ameca.

General characters.—Similar in size to typical *bulleri*; general color slightly darker; white facial marking absent, or less extensive than in *bulleri*; skull slenderer. Somewhat like *albinasus*, but decidedly smaller; white nasal patch absent or smaller; skull slenderer.

Color.—Type (unworn pelage): Upper parts between "cinnamon" and "orange-cinnamon", finely and inconspicuously sprinkled with black; under parts overlaid with "cinnamon-buff"; chin and throat, lining of cheek pouches, and under sides of wrists whitish; white nasal patch, usual in the group, very faintly indicated; ears narrowly encircled with black; feet dull whitish; tail nearly naked, a few scattered grayish hairs near tip, the dry skin yellowish all around. In one specimen the white nasal patch is absent; in others present but very small.

Skull.—Similar to that of *bulleri* but slenderer; rostrum narrower, less flattened, the premaxillae more depressed along lines of contact with nasals; zygomata less widely but more squarely spreading, less divergent anteriorly, the sides more nearly parallel; dentition about the same. Compared with that of *albinasus* the skull is very similar in general form, but much smaller and lighter.

Measurements.—Type: Total length, 214 mm; tail vertebrae, 65; hind foot, 28. Average of three adult male topotypes: 214; 65; 28.5. Two adult female topotypes, respectively: 192, 201; 53.5, 64; 27, 27.5. *Skull* (type, male, and an adult female topotype, respectively): Occipitonasal length, 38.1, 36.2; zygomatic breadth, 22.8, 21.4; width across squamosals (over mastoids), 21.5, 20.3; interorbital constriction, 6.5, 7.3; length of nasals, 12.9, 11.8; maxillary toothrow (alveoli), 7.8, 7.5; width of upper incisors (cutting edge), 4.4, 3.8.

Remarks.—This race is much like typical *bulleri* in external appearance, but the white nasal patch is reduced in size, and there are only faint traces of the white flecking radiating from near the nose and covering much of the head in the latter form. More reliable differential characters, especially the slenderer rostrum, are presented by the skull.

Specimens examined.—Six, from the type locality.

Pappogeomys bulleri burti, subsp. nov.

Type.—From Tenacatita Bay, southwest coast of Jalisco, Mexico. No. 81017, ♀ adult, skin and skull, Museum of Zoology, University of Michigan; collected by William H. Burt, February 19, 1938.

Distribution.—Known only from the type locality.

General characters.—A large subspecies, about equal in size to *albinasus*, pelage shorter; color peculiar, in the single known specimen nearly uniform "deep mouse gray" above, only slightly paler below; skull with narrower braincase than in *albinasus*, and differing in other details. Size decidedly larger than in typical *bulleri*, and cranial characters distinctive.

Color.—Type (acquiring fresh pelage): Upper parts in general "deep mouse gray"; under parts somewhat paler, near "mouse gray", except a patch on chin which is whitish; nasal pad narrowly bordered with white; forearms and thighs about like under parts; hind feet nearly naked, thinly and inconspicuously clothed above with very short grayish hairs, the dry skin yellowish; tail naked, the skin yellowish above and below.

Skull.—Similar in general to that of *albinasus*, but braincase narrower, more highly arched; squamosals narrower, less projecting as lateral shelves over glenoid fossae; supraoccipital narrower in transverse section at constriction between mastoids; nasals longer; maxillary arms of zygomata heavier; mastoid bullae smaller, more truncate above; dentition heavier. Compared with that of *bulleri* the skull is much larger and heavier, and differs otherwise in about the same characters as from *albinasus*.

Measurements.—Type: Total length, 231 mm; tail vertebrae, 68; hind foot, 33. *Skull* (type): Occipitonasal length, 42.8; zygomatic breadth, 25.9; width across squamosals (over mastoids), 22.9; interorbital constriction, 7.5; length of nasals, 15.5; maxillary toothrow (alveoli), 9.2; width of upper incisors (cutting edge), 4.9.

Remarks.—Pappogeomys bulleri burti is based on a single adult specimen presenting characters beyond the usual range of individual variation in the genus. The discovery of the animal at Tenacatita Bay notably extends the known altitudinal range of the genus downward in the Tropical Zone to near sea level. The new form is named for the collector, William H. Burt, to whom I am indebted for the privilege of inserting its description here.

Biological Survey, U. S. Department of Agriculture, Washington, D. C.

THE STATUS OF PEROMYSCUS LEUCOPUS AMMODYTES BANGS

By Philip F. Allan

Monomoy Island, Massachusetts, a long, low spit of sand of post-glacial origin, has been intermittently connected with the mainland of Cape Cod during recent times. Attached to the mainland by a low sandy beach, it extends ten miles south of the town of Chatham at the "elbow" of the Cape, and is from ½ to ¾ miles wide. A 30-foot sand dune extends down the middle of the spit, flanked by one to three parallel dunes in the wider portions. Between the dunes are grassy flats with a few small ponds. Vegetation is sparse and predominantly grassy. *Ammophila* and *Spartina* are the dominant grass genera. *Lathyrus maritimus* and two species of *Artemisia* are locally common. There are small thickets of *Prunus maritima*, *Rhus toxicodendron*, *Rosa sp.* and *Rubus sp.*; also a few stunted pines, *Pinus rigida*, and a small clump of oaks. The loose sand offers a precarious foothold for plants, and in no place is plant growth heavy.

From this island Bangs in 1905 described a subspecies of deer mouse, *Peromyscus leucopus ammodytes*. At that time the mouse was very abundant. The differentiating characters of the animal were directly correlated with the sandy habitat in which it was found, and the subspecific name indicated its "sand-burrowing" habits.

Briefly, the characteristics of *Peromyscus leucopus ammodytes* may be

stated as follows: "Rather smaller than *Peromyscus leucopus noveboracensis*, with a shorter tail—not relatively shorter, as all the proportions are about the same. Colors very pale,—above pale gray, below pure white to base of hairs. Skull small but robust; tail, above very pale grayish, below white." (Bangs 1905.) Using the extremes of a wide variation of individuals as his type and paratype specimens, Bangs gave the following color characteristics: ". . . . upper parts pale grayish fawn color, an ill-defined darker dorsal stripe drab; under parts pure white to base of hairs; feet and hands white; tail indistinctly bicolor, pale gray above, white below, ears (in dried skin) pale drab, nearly naked, the few short hairs silvery." Bangs obtained every degree of variation from those indistinguishable from specimens of the mainland to the extremes mentioned above. Osgood (1909) considers that Bangs' collection of twenty-five individuals contained thirteen typical *ammodytes* and twelve intermediates or *noveboracensis*. One gathers, therefore, that *ammodytes* and those approaching it predominated.

Bangs considered the development of the subspecies to have been rapid, for he said, ". . . . if he wore his usual coat of reddish brown he would stand out like a red rag on the white sand and among the gray grasses." He mentioned, however, that the island had been intermittently connected with the mainland; and mice from the mainland had worked in and "infused into the island form the very characteristics it was struggling to eliminate."

Professor Henry Mitchell (1887) determined the rate of extension of Monomoy Island as about two miles in a century. If his assumption is correct, it took approximately 500 years to build Monomoy to its present state. A somewhat comparable sand spit on Nantucket Island, according to Shaler (1889), may have developed since settlement by white men—a period of approximately 300 years. This gives some insight as to the probable rapidity of the development of the Monomoy Island mouse.

During the summer of 1931, the writer, on a field trip financed by the William P. Harris, Jr. Research Fund in the Museum of Zoology, University of Michigan, spent several days on Monomoy, covering the period from July 2 to 16, inclusive. During this period 75 traps were set for a total of 14 nights. The trap-lines were changed four times during the two weeks in order to cover all possible variations in the habitat of the mouse.

The first noticeable departure from Bangs' experience on Monomoy was in the different abundance of the mice. While he had found them very abundant, the writer had difficulty in collecting 27. The frequent burrows mentioned by Bangs were not apparent in 1931.

Several factors may limit the numbers of mice on Monomoy. Fire is, perhaps, the major limitation to abundance. Large sections of Monomoy are regularly burned by the Coast Guard to minimize the fire hazard to their buildings. Many predators of mice occur on Monomoy. Skunks, marsh hawks, and crows are abundant. Feral house cats were often seen. Foxes,

according to Bangs, come in from the mainland, although none were seen by the writer. Again, the apparent scarcity during 1931 may have been due partially to the adverse weather conditions that existed early in July. Rain and fog every day made the bait soggy, despite the fact that the traps were covered.

Through the courtesy of the Museum of Comparative Zoölogy, the writer was able to examine in the fall of 1931 six specimens of the type series of *Peromyscus leucopus ammodytes*. These were compared with those obtained in 1931, which are now in the collection of the Museum of Zoölogy, University of Michigan. The single specimen in the latter collection which most closely approached *ammodytes* was several shades darker than the darkest of the six from Bangs' collection. Although this specimen is lighter in color than any other in the writer's collection from Monomoy and the adjacent mainland, it still falls within the range of color of *Peromyscus leucopus noveboracensis*. In this animal the upper parts are tawny-olive, with the dorsal stripe the same except for an admixture of darker hairs; below white with neutral gray underfur (rather than plumbeous as in *noveboracensis* or white as in *ammodytes*) but shading anteriorly into white; tail above sepia, below white. The cheeks are snowy white to the base of the hairs. This individual was slightly smaller than the type specimen. The average size of those in the remainder of the writer's collection was slightly larger than those in the type series. Only two others differed in any respect from the mice of the mainland, both having snowy white underfur on the belly.

While the smallness of the series collected in 1931 precludes definite conclusions, it appears that Monomoy is now inhabited only by a population of *Peromyscus leucopus noveboracensis* that retains a slight remnant of *ammodytes* characters. It appears, therefore, that a connection between Monomoy Island and the mainland of a more permanent nature than those mentioned by Bangs, has permitted an influx of the mainland subspecies which is swamping out the characteristics of *ammodytes*. Any permanent connection probably was subsequent to 1916, for a map prepared by B. K. Emerson under that date and published in U. S. Geological Survey Bulletin, No. 597, 1917, shows Monomoy Island detached from the mainland. One assumes that in the fifteen years following, a connection was established that permitted continuous influx of mice from the mainland and the effect has been rapid. From the evidence at hand it appears that *Peromyscus leucopus ammodytes* is extinct as a subspecies, although some individuals still retain some of the *ammodytes* characters.

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GENERAL NOTES

SOREX FONTINALIS IN VIRGINIA

During the month of February, 1938, while I was trapping in a damp, wooded area in Virginia six miles from Washington, D. C., seven specimens of *Sorex fontinalis* Hollister, the Maryland shrew, were taken. Identification was verified by Gerrit S. Miller, Jr. of the National Museum. This is the first record of this species in Virginia, as all other specimens from the vicinity of Washington have been taken in Maryland. It is the second record for the species west of the District of Columbia. Four of the specimens caught were males, and one a female, while two were not sexed. The first two caught, sex undetermined, were deposited in the National Museum. The remaining five are in my collection.

The area in which these long-tailed shrews were taken is situated about two miles southwest of Chain Bridge and near the small community of Vanderwerken, Va. The shrews were caught on both sides of a tributary of Little Pimmit Run. The ground of the area is low, and is soft and muddy in some places. No sphagnum moss is to be found in the area in which the shrews were captured, although there is a small patch about one hundred feet from the nearest spot at which a shrew was taken. Traps set in and around the sphagnum section yielded no shrews. All shrews were caught within a long quadrangle about sixteen hundred square yards in area. Second growth trees cover the section, mostly oaks, gums and sycamores. Many fallen logs lie in a thick carpet of leaves, the whole being entwined by a rich growth of honeysuckle vines. All but one of the shrews were caught in runways around the fallen logs. All traps were baited with peanut butter. In each case the specimens were found frozen when the traps were visited in the early morning.—ROBERT S. BRAY, *George Washington University, Washington, D. C.*

AN EXTENSION OF THE KNOWN RANGE OF NOTIOSOREX CRAWFORDI

On November 2, 1938, I received from Sidney B. Peyton, of Fillmore, California, a living female *Notiosorex crawfordi*. It died two days later and was preserved as a specimen, skin and skull no. 5051, Los Angeles Museum. Mr. Peyton informs me that he secured the shrew on November 1, in Timber Canyon, about five miles northeast of Santa Paula, Ventura County, California. This, I believe, is the most northern record for *Notiosorex* in the state.

An interesting feature in this capture is that, as in several previously recorded instances, the animal was found in a bee hive in which the bees had been destroyed by the bee moth (*Galleria melonella*). The shrew was assumed to be feeding upon the larvae of this moth.—G. WILLETT, *Los Angeles Museum, Los Angeles, California.*

MAMMAL DISTRIBUTIONAL RECORDS FOR KANSAS

The hoary bat (*Lasiurus cinereus*), formerly recorded from Kansas only from Riley, Douglas, Anderson and Woodson counties, was taken at Pratt, Kansas, July 17, 1938. Two specimens, adult ♀ and young ♀, still clinging to the mother, were taken by Leo Brown at the State Fish Hatchery. This record extends the known range of the hoary bat in Kansas some 130 miles to the west. The young measured 80 mm. and was covered with a coat of short, gray fur.

While trapping near Cedarvale, Chautauqua County, Kansas, I took a specimen, adult ♂, of *Reithrodontomys fulvescens aurantius*. This record extends the known range of this mouse in Kansas more than 100 miles to the west. The specimen was taken at the foot of one of the several hills surrounding Cedarvale in a dense growth of weeds edging a field of wheat stubble. Adjacent to the weed patch was a heavy growth of oaks intermixed with cedars. Other than this specimen, the Museum of

Mammals has two records of the golden harvest mouse in Kansas, from Cherokee County in the extreme southeastern corner of the state. This would seem to indicate that *Reithrodontomys fulvescens aurantius* is a rare inhabitant of the state, although future trapping may prove it to be locally common.—JAMES M. SPRAGUE, *Museum of Birds and Mammals, Lawrence, Kansas.*

THE RAFINESQUE BAT IN MICHIGAN

On May 23, 1938, Mr. H. R. Becker caught an adult female bat, *Nycticeius humeralis* (Rafinesque), on the window of his home at Climax, Kalamazoo County, Michigan. The bat was sent alive to the Museum of Zoology where it was made into a specimen. Upon dissection, it was found to contain two well developed embryos. This is the first record of the Rafinesque bat for Michigan and, I believe, the northernmost record for the genus. This specimen establishes the species as breeding in the state and future collecting will probably show that it ranges over much of southwestern Michigan.—WILLIAM HENRY BURT, *Museum of Zoology, Ann Arbor, Michigan.*

THE SPOTTED BAT IN KERN COUNTY, CALIFORNIA

To the 7 records of occurrence for *Euderma maculatum* (J. A. Allen) mentioned by Durrant (Jour. Mammalogy, vol. 16, p. 226, 1935) I am able to add an eighth. The specimen is a female, preserved in alcohol, in the Museum of Vertebrate Zoology with catalogue number 61931. It was a gift from Mr. Axel L. Petersen, of Bakersfield, California. The bat was found alive in the early part of December, 1933, by Mrs. W. C. Sowell, also of Bakersfield, "one afternoon . . . clinging to the lower side of a rock . . . [at the base of a] cliff . . . in Red Rock Canyon [Kern County, California] . . . between thirty and forty miles [north] from the town of Mojave." This information from Mr. Sowell he supplemented with the following: The bat . . . "had apparently been injured on one wing [but] . . . when caught had plenty of fight. . . . He clicked his teeth together and made a hissing noise whenever disturbed. He also squeaked like a rat. He was able to reach out with his wings and pull himself along with any of the claws on his wings. We kept him in a box for over a week, but could not find anything that he would eat. We gave it to a student at the high school . . . and while there the bat died."—E. RAYMOND HALL, *Museum of Vertebrate Zoology, Berkeley, California.*

NOTES ON THE FOOD OF SOME FLORIDA BATS

Little published information is available concerning the food of bats in the southeastern states other than that they feed chiefly on flying insects. In order to obtain more definite information on this subject, slides were prepared of the stomach contents of 11 specimens of bats taken in the region of Gainesville, Florida. The classification of the insects eaten, from these well masticated fragments, required the aid of an expert and well equipped entomologist. For this assistance I am indebted to the U. S. Biological Survey. Mr. J. R. Malloch made the determinations.

The stomach contents examined were taken from the following bats: 8 from the free-tailed bat, *Tadarida cynocephala*; and 1 each from the Seminole bat, *Lasiurus seminolus*; the yellow bat, *Dasypterus floridanus*; and the Georgian bat, *Pipistrellus subflavus subflavus*. All but 2 of these specimens were taken in May. A *Tadarida* (number 6 of the table) was taken in April and the *Dasypterus* was taken in August.

The food items identified from each of these specimens are listed in the table on page 104.

In addition to insects, a mite was present in the stomach of the Seminole bat examined. The only other information at hand concerning the natural food of the 4 species of bats under discussion is in reference to the Seminole bat. A green fly,

	TADARIDA CYNOCEPHALA								LASIURUS SEMINOLA	DASYPTERUS FLORIDANUS	PIPISTRELLUS S. SUBFLAVUS
	1	2	3	4	5	6	7	8			
Homoptera	....	....	x	....	....	....	....	....	x	x	....
Jassidae	....	....	....	....	....	....	....	....	x	....	....
Fulgoridae	x	....	....	....	....	....	....	....	....	....	....
Odonata	x	....	....	....	....	....	....	....	....	....	....
Anisoptera. Libellula	x	....	....	....	....	....	....	....	....	....	....
Zygoptera	....	....	....	....	....	....	....	....	....	x	....
Neuroptera	....	....	....	....	....	....	....	....	....	....	....
Neuropteridae	....	....	....	....	....	x	....	....	....	....	....
Lepidoptera	x	x	x	....	....	....	x	x	....	....	....
Noctuidae	....	....	....	....	....	x	....	....	....	....	....
Microlepidoptera	....	x	....	....	....	x	....	....	....	....	....
Diptera	....	....	x	....	....	x	x	....	....	....	x
Tipulidae	x	....	....	....	....	....	....	....	....	....	....
Chironomidae	x	....	x	....	....	....	x	x	....	....	....
Dolichopodidae	....	....	....	....	....	....	....	....	x	....	....
Muscidae	....	....	....	....	....	....	....	....	x	....	....
Sciaridae. Sciara	....	....	....	....	x	....	....	....	....	....	....
Anthomyiidae	....	....	....	....	....	....	....	....	....	x	x
Coleoptera	....	....	....	x	x	....	x	x	x	x	....
Dytiscidae	....	....	....	....	....	....	....	....	....	x	....
Scolytidae	....	....	....	....	....	....	....	....	x	x	....
Hymenoptera	....	....	x	....	....	....	....	....	....	....	....
Formicinae, winged form	....	....	....	x	x	x	x	x	....	....	x
Myrmicinae, winged form	....	....	x	x	x	....	x	....	....	x	....
Myrmica, winged form	....	....	....	....	....	....	x	....	....	....	....
Chalcidae	....	....	....	....	x	....	x	....	....	....	....

Tabanus flavus, is recorded by Harper as being in the mouth of a recently shot specimen of this bat (The mammals of the Okefinokee Swamp region of Georgia, Proc. Boston Soc. Nat. Hist., vol. 38, p. 276, 1927) and a flightless cricket, *Gryllus assimilis* variant *pennsylvanicus*, was found in the mouth of a recently shot Seminole bat by the present author (Jour. Mamm., vol. 16, p. 224, 1935).

It seems noteworthy that 6 of the 8 *Tadarida* examined had eaten Lepidoptera while no remains of these insects were found in the stomachs of the three vespertilionids.—H. B. SHERMAN, *Department of Biology, University of Florida, Gainesville, Fla.*

COYOTES IN MAINE

Before 1900, wolves were native to the State of Maine, but since that date no authentic records are known of their having been seen. A supposed wolf, shot in November, 1936, was brought to my attention; but this animal proved to be a coyote of the plains variety and not a wolf as had been reported and widely publicized. This proved to be the second record for coyotes taken in the state, one having been captured near Portland in 1932. Unlike the wolf, the coyote was never native in Maine.

In November, 1936, Ross McKenney shot an animal that he called a male wolf in the northwest corner of Argyle Township, Penobscot County. The pelt was turned over to Harold Casey, a taxidermist of Milford, who had it tanned.

On November 11, 1936, the writer, accompanied Dr. W. B. Bell, Dr. H. H. T. Jackson, and Leo K. Couch, all of the Biological Survey, examined this skin. All were in accord that the animal was a coyote, very closely resembling the plains species, *Canis latrans*. It was not possible to obtain the skull with which to make a positive identification.

In January, 1937, Percy Storer trapped what appeared to be another of these animals, an adult male. It was taken in Edinburg Township, about four miles north of the place where Mr. McKenney had made his capture. I saw this animal and identified it as a coyote.

The following weight and measurements were taken: Weight, 32 pounds; total length, 51 inches; tail, 13½ inches; hind foot, 7⅓ inches; ear, from notch, 4¼ inches.

In May, 1937, Maurice Stevens, of South Lincoln, trapped what was probably a male coyote in the Edinburg bog near the northern edge of Edinburg Township. I did not see this animal, but according to game wardens Malloy and Chaples, it closely resembled the one taken by Mr. McKenney.

In April, 1938, Leo Ross trapped an adult female in the northern part of Edinburg Township. The pelt resembled that of a typical coyote, with the single exception of being very dark in color. The skull was procured and sent to the Biological Survey at Washington, where Major E. A. Goldman and Dr. H. H. T. Jackson compared it with typical coyote skulls. They were of the opinion that this animal might possibly be a cross, as the skull showed some characters common both to the dog and to the coyote.

In May, Clyde Hichburn found two coyote-like pups near a den in the southern portion of Medford Township immediately north of Edinburg. He shot one of these pups and sent the pelt to the Department of Inland Fisheries and Game as evidence for the bounty claim. Maurice Stevens later accompanied Mr. Hichburn to the site of the den, but it showed no evidence of having been used for some time.

Maurice Stevens was successful in trapping a male coyote in May of this year in Edinburg Township. I examined this animal and obtained the following data: Weight, 30 pounds; total length, 50½ inches; tail, 14 inches; hind foot, 7¾ inches; ear, from notch, 4½ inches.

The skull was saved and sent to the Biological Survey where it was identified by E. A. Goldman as that of a coyote in every respect except that the canine teeth are shorter. Of this skull Major Goldman says: "I compared it with a considerable number of coyotes from various regions, and could not find one in which the teeth were so short. My conclusion would be that this animal may be a cross, but I think it is about the closest to a typical coyote of any of the skulls from various regions that I have examined, and that showed evidence of crossing."

Mr. Stevens also trapped a female during May. He brought the animal alive to his home and held it in a crate for about two days.

Two months elapsed before Mr. Stevens was successful in getting another animal. In July, he trapped a pup, sex not recorded. The skull was sent to Washington where E. A. Goldman examined it and reported that it was difficult to make positive identification, but he stated that it would be hard to tell it from a coyote.

Two more male coyote-like animals were taken by Mr. Stevens in Edinburg Township in August of this year. The skulls were sent to the Biological Survey for identification. Major Goldman, after examining these two skulls, reports: "These two are clearly not full-blooded coyotes, although the skulls resemble coyote skulls in a number of respects . . . and while I can say positively that the skulls are not from full-blooded coyotes they might possibly be of dogs, or perhaps under the circumstances what is more likely the result of a coyote-dog cross. Both of these are adults and are larger and heavier than coyotes, with shorter canine teeth, and they differ in a number of other details."

During the latter part of August, 1938, two pups were trapped by Mr. Stevens in Edinburg Township and taken to his residence alive. These two half-grown animals were caught on the same day within a few rods of each other. It was evident that these

pups were of mixed blood. One resembled the typical coyote and dog cross, while the other one showed the red coloration typical of the red fox, although the tail resembled that of the coyote. It was decided to transfer these pups to the State Game Farm at Gray, where they are being held for observation and study.

On January 11, 1932, a coyote was shot in Portland, Maine, according to a report by A. H. Norton, Curator of the Portland Museum of Natural History. Some time afterward, it was learned that it was an escaped pet brought to Maine from Texas.

It is interesting to note that all these captures were made in a very localized area. Seven of the 12 animals were taken within a radius of a mile, and 10 of them were caught in Edinburg Township. Just how these animals came to this restricted area is still a mystery, but it is highly probable that some individual procured one or more of them for pets from the western part of the country and then, either by accident or by deliberate intent, released them.

About a year ago, the State of Maine set up a $25 bounty fee for each one of these animals taken. Mr. Stevens and another trapper have now been employed by the State on a monthly basis to concentrate their efforts toward their extermination.—Clarence M. Aldous, *Bureau of Biological Survey, University of Maine, Orono, Maine.*

A WHITE-FOOTED BOBCAT

During August, 1938, W. B. Gunnoe, a Biological Survey hunter, of the Yakima district, Wash., collected a bobcat that had two white front feet, and District Agent John Finley forwarded one of the feet to the Washington, D. C., office of the Survey for examination. The toes are pure white, top and bottom, for 1½ inches from the tip of the longest toes and ¾ inch from the tips of the smaller toes. The rest of the top and sides of the foot is a little darker than tilleul buff, and all indications of spots are lacking. A narrow stripe of black borders the base of the toes instead of the usual dark brown color. There is a sharp line of demarcation between the white and the darker colors. This is the only specimen of a white-toed bobcat that has been received in the Survey's mammal collection.—Viola S. Schantz, *U. S. Biological Survey, Washington, D. C.*

GROUND SQUIRREL CAPTURED BY A GOPHER SNAKE

Just after sundown on July 25, 1938, while in company with Dr. Harold Biswell at the San Joaquin Forest and Range Experiment Station, Madera County, Calif., we observed an interesting incident in the life of a young ground squirrel (*Citellus beecheyi fisheri*). Our attention was first attracted to a small rock outcrop by the insistent alarm notes of a half-grown ground squirrel. Closer observation revealed the presence of a gopher snake (*Pituophis catenifer*) which held another young squirrel in its coils. A third squirrel, apparently a member of the same family group was also seen nearby. The snake was wedged in a 4-inch crevice of the rock and was apparently utilizing the sides of the crevice for leverage. It had thrown four coils around its victim, which was motionless and made no attempt to escape. When the snake was picked up, however, it released its hold on the young squirrel, which fell to the ground and immediately ran under the rock shelter. The snake did not hold the squirrel with its mouth, but depended entirely upon the constricting power of its coils. A damp spot between the shoulder blades of the squirrel may have marked the place where the snake struck. No other marks of injury were noticed. Examination of the site led to the conclusion that the snake had lain in wait in the crevice, which showed signs of use as a squirrel runway, and had seized the squirrel as it passed by.—Clarence F. Smith, *U. S. Biological Survey, Washington, D. C.*

GOLDEN-MANTLED GROUND SQUIRRELS RAISED IN CAPTIVITY

Sierra Nevada golden-mantled ground squirrels (*Callospermophilus chrysodeirus chrysodeirus*) have been shown recently, along with several other native California

rodents, to be capable of harboring *Pasturella pestis*, the causative organism of bubonic plague. Inasmuch as there appear to be no records of raising this rodent in captivity, the following may be of interest.

In June 1934 the writer and his family, accompanied by Mr. and Mrs. Lester M. Bonar, camped at Andrew's Camp on the South Fork of Bishop Creek, elevation 8100 feet, on the eastern side of the Sierra Nevada in California. At that time the golden-mantled ground squirrels were very abundant in the vicinity and six live individuals, three males and three females, were trapped. One of the males died shortly after the entire group was dusted with sodium fluoride in order to kill the fleas that were altogether too abundant. Of the remaining five, three (a male and two females) were kept in an outdoor cage, 5 x 6 x 6 feet, in Los Angeles by the writer, while the other two, a pair, were taken by the Bonars to their home in Arcadia, California, and placed in a large outdoor aviary, previously used for canaries.

Both groups of squirrels were fed quite similar diets of liberal amounts of oranges, dry bread, cabbage, sunflower seeds, scratch feed, cantaloupes, and nuts, especially walnuts; and as a result by fall the animals became very fat, as they normally do under natural conditions. All of the animals hibernated during the winter in sections of hollow cottonwood logs placed in the cages for that purpose. No definite records were kept of the lengths of the periods of hibernation, but it was noticed that not all of the animals hibernated at the same time. One of the females went into hibernation the latter part of September, and one male was seen frequently during November and December. In the late winter after hibernation and in the early spring the animals did a great deal of chasing one another around the cage, which frequently led to fighting accompanied by considerable squealing, so that the Bonars placed their male squirrel in a separate cage. Sometime during the late spring (1935), date unknown, two young were born.

This pair was successfully raised and in the fall they were placed in separate but adjacent cages. For some weeks after they emerged from hibernation in the following spring (1936) these two squirrels spent a large portion of the time attempting to get through the wire mesh that separated their cages. When the female was placed in the cage with the male in February they seemed to get along together very well for ten days or two weeks after which they were again separated because they fought continuously. Later on in the spring five young squirrels, three-fourths of an inch in length, were found in the nest with the female. This litter was of the second generation born in captivity. It was a month or six weeks before the young ones, about the size of a man's thumb, first crawled out of the hole in the log. In September of 1936 when the five young squirrels were five or six months old they were liberated near Big Bear in the San Bernardino Mountains. The fact that no young were raised by the male and two females kept together from June 1934 to January 1938 by the writer may possibly be explained by assuming that the young, if there were any, were eaten by the adults.—RAYMOND M. SELLE, *Department of Biology, Occidental College, Los Angeles, Calif.*

CHIPMUNKS AND BIRDS

The food habits of the Eastern chipmunk, *Tamias striatus*, apparently are somewhat undetermined. Some students of natural history say that this animal eats birds' eggs and young, whereas others do not mention this food.

While studying the habits of the Carolina junco, *Junco hyemalis carolinensis*, at the Mountain Lake Biological Station, Mountain Lake, Virginia, I saw a chipmunk robbing a nest of its three-day old young. After the fourth nestling had been carried away, he came back to the empty nest, evidently looking for another. He entered the nest, turned around and looked out at the adults who were flying wildly about, making every effort to drive him away.

Later in the summer one of the station instructors saw a chipmunk seize a young

robin which had just flown from its nest. The fledgling was rescued but died from the wounds.

In my study of the junco, I have lost many nests containing either eggs or young. Probably the destruction of nests by chipmunks is greater than is generally supposed. —D. RALPH HOSTETTER, *Harrisonburg, Va.*

THE TRANSFER OF A PEROMYSCUS FAMILY

The following observations, made at Wells River, Vermont, probably concern *Peromyscus leucopus noveboracensis*, which is more common in this locality than *P. maniculatus gracilis*. As no specimens were collected, however, identity is not certain.

On September 29, 1937, some workmen, while harvesting potatoes, exhumed a nest of a white-footed mouse containing seven young at least two-thirds grown. The nest was composed of dried grasses, rather loosely woven and was placed at a depth of two inches below the surface of the ground in a potato hill. It was little injured by the accidental removal and was left on the surface until found at 11.25 A.M., when the seven young were still inside. At 11.32 an adult *Peromyscus* was seen to approach the nest from the edge of the grass, four feet away. It nosed about the nest until it located the opening, entered and removed one of the young. The method of carrying was by holding the skin of the back, in the middle or lower down in some cases, between the teeth. The return journey was accomplished in this way and the adult with its burden disappeared in the grass at the place from which it had emerged only a few seconds before. At 11.33, one minute later, the adult reappeared, bringing the young mouse back to the nest. Eight minutes later (11.41), the adult came again to the nest and removed one of the young, this time breaking through the nest wall without stopping to find the entrance. A second young one was carried off at 11.49½ and two more at 11.57 and 12.02½, respectively. At that time I went away. On returning at 1.15 P.M. I found the nest empty. If the same rate of removal was maintained throughout the operation, the transfer would have been completed before 12.30 P.M. This would allow approximately three and one-half hours for the selection of a new nesting site, the nest's construction, and the removal process, for it was about 9.00 A.M. when the occupied nest was rendered uninhabitable.

The behavior of the adult while engaged in the work of removal was interesting. When first emerging from the concealment of the grass, it always paused, looking about and listening intently. That hearing was the main dependence was evidenced by its failure to notice the presence of the observer more than once, although I was in plain view at a distance of ten feet. After reassuring itself, the adult ran to the nest, often making one or two more pauses before reaching it. The journey back while carrying the young was always made in jumps and without any pauses. The burden seemingly was carried easily; but once in attempting to hurdle a clod, a fall occurred and the young mouse was dropped but quickly recovered and the journey resumed.

I could not find the location of the second nest, losing the trail in a maze of runways a short distance beyond the edge of the grass.—WENDELL P. SMITH, *Wells River, Vermont.*

TRAPPING OCHOTONA

While trapping for flying squirrels in Pend-Oreille Co., Washington, last spring, I baited one trap with a prune and set it at the edge of a talus slide. An hour later a specimen of *Ochotona princeps cuppes* was in the trap. Five traps were then baited with prunes and set in the talus slide. A fine series of *Ochotona*, *Neotoma*, *Clethrionomys*, *Microtus*, *Peromyscus*, *Citellus*, and *Eutamias* was taken in a very short time. Trapping for *Ochotona* with prunes was successful in June and September in the Pend-Oreille Mountains, in September in the Kettle River Range, and in October in the Cascades.

In the past collectors have been able to trap *Ochotona* only with great difficulty, by using fresh leaves. Most collectors shoot their specimens. By using dried prunes in rat traps good series of perfect specimens can readily be taken.—WALTER W. DALQUEST, *University of Washington, Seattle, Washington.*

SOME BIOCHEMICAL ASPECTS OF DEER LICKS

We have evidence that the native Indian tribes of North America, even before the coming of white men to America, were familiar with the fact that many of our species of deer, bison, caribou, antelope and mountain sheep regularly visited certain mineral springs or mineral deposits where they drank the water and even licked the rock in order to secure the benefit of minerals that were in solution in the water or deposited in the rock. Such mineral springs are commonly known as "salt licks".

These mineral springs attracted deer and other game animals in the neighborhood and the deer in turn attracted both Indians and cougars. Thus many enemies lay in wait for the deer at the salt licks. With the coming of the white man the levy on deer for meat and buckskin at the deer licks was greatly increased and the deer had no escape.

In Mount McKinley National Park I was interested to find that the Dall sheep, Alaska moose and Stone's caribou all had certain mineral springs which they visited regularly, particularly in the late spring or early summer at the time of molt. In the caribou and Dall sheep I found that the pregnant females made the most frequent visits to these licks in the spring *before* their young were born. This is believed to be the reason why more females than male sheep visited a certain mineral spring on Ewe Creek at Mount McKinley National Park. Well-worn sheep trails led from the higher ridges down across the gravelly plain to the spring which was located along the high banks of a stream. At this point several beds of purplish talc were exposed and an area of about twenty by thirty feet was literally covered with Dall sheep tracks where the mammals had come to lick and to gnaw off portions of the soft rock which in places had been undercut to a depth of six to eight inches. I sampled a piece of the broken rock but there was no decided taste that I could detect. Pieces of this rock were saved and brought back to the University of California where they were analyzed by Dr. G. L. Foster, of the Division of Biochemistry, who reported that calcium and iron phosphate were the minerals present which would be soluble in digestive fluids. Insoluble substances, notably magnesia and silicates, were also found.

In Thibaut Canyon, on the Owens Valley face of the Sierra Nevada, near Mount Baxter on September 8, 1935, I jumped eight Inyo mule deer, five does and three fawns. Near the spot where these deer were bedded I found a mineral spring which was much used as a lick by the deer. The chief minerals of this spring appeared to consist of sodium, iron and sulphur.

Above Big Meadows in Yosemite National Park, I found a mineral spring much used not only by deer but also by black bear and porcupines. A sample of the oxide was submitted to the U. S. Geological Survey, which replied: The sample resembles in its chemical and optical characters the mineral copiapite, the commonest of a group of hydrated ferric sulphates. Copiapite is generally formed by oxidation of iron sulphide and other material partly neutralized, the resultant ferric sulphate being readily precipitated as a basic salt.

Upon my request, Professor Greenberg of the Biochemistry Department at the University of California made an analysis of this deposit and found as follows: iron—a small amount (trace); calcium chloride (about one-third of total deposit); sodium chloride (about one-half of total deposit). Tests for phosphate, iodine and potassium were all negative.—JOSEPH S. DIXON, *National Park Service, Berkeley, California.*

BOHLINELLA, A NEW NAME FOR DEPERETIA SHIKAMA

In 1936 Shikama proposed a new genus *Deperetia* for *Cervus prænipponicus* from the Pliocene or Pleistocene of Japan. As this name had already been used by Shaub in 1923 for an extinct antelope from the Pliocene of France it is not available for any other animal. Since the Japanese deer requires a new designation it may be named *Bohlinella* in honor of Anders Birger Bohlin, well known for his researches on the fossil mammals of Eastern Asia.—T. S. Palmer, *Washington, D. C.*

SMALL MAMMALS TRAPPED BY PLANTS

A few observers have recorded the trapping of mammals by natural hazards. Bats have been snagged by burdocks, while deer occasionally catch a leg in the crotch of a tree, becoming securely imprisoned. The rôle of grasses and ground vines as a natural hazard has not been emphasized, so the few records obtained by the writer seem worthy of record.

During a number of years' intensive study of the eastern field mouse (*Microtus pennsylvanicus pennsylvanicus*) at Ithaca, New York, in which several thousand have been trapped, I have found three mice firmly caught by the long dead stalks and leaves of quack grass (*Agropyron repens*). In two instances the mice had been dead for several days or more, while in the third instance the mouse was nearly dead. All were found in late winter or early spring. In each case the grass had become entangled either about the hind limb or hips of the mice, and in the resultant struggles of the animal to free itself, the grass had tightened.

While collecting plants on the Edmund Niles Huyck Preserve, Rensselaerville, Albany County, New York on August 28, 1938, I chanced upon a chipmunk (*Tamias striatus lysteri*) held fast by the prostrate stems of ground ivy (*Nepeta hederacea*). Several stems were firmly twisted about the hind limbs and groin of the animal, forming an inextricable trap. It seemed obvious that the rodent might readily have escaped when first caught, but its furious struggles to free itself had soon resulted in complete exhaustion and the chipmunk was nearly dead when found. It showed no signs of recovery when freed, and died within two hours of its release. A large *Cuterebra* larva had nearly freed itself from its skin pouch in the groin when the chipmunk was found.

It appeared probable that in each instance the animal might have freed itself readily by employing its strong incisors to cut itself free when first caught, but its frantic struggles to free itself by tugging and pulling immediately upon capture soon exhausted it. —W. J. Hamilton, Jr., *Cornell University, Ithaca, New York.*

NOTES ON MAMMAL MORTALITY ON HIGHWAYS

During the latter part of July, 1938, while driving on U. S. Highway 83, I made a count of jack-rabbits (*Lepus californicus melanotis*) killed by automobiles. I began this count 40 miles south of Garden City, Kansas, and terminated it at Garden City, counting the number of carcasses per mile of highway, read from the car speedometer. The area through which this stretch of highway ran was of two general types. For the first 33 miles, the country on both sides of the road was cultivated, mostly in wheat which had been cut, only the stubble remaining; for the last 7 miles the area was of sage and grass flats interspersed with sand hills. The rabbits living in the cultivated area were forced, because of the lack of food in the stubble, to resort to the roadside ditches to feed on the vegetation growing there. In consequence, many were killed by automobiles. As the natural vegetation of the flats and sandhills was sufficient for the jacks, few of these crossed the highway and were killed. Along the highway through the cultivated area (33 miles) jack rabbit carcasses totaled 175, and averaged 5.3 per mile, the

minimum being 1, the maximum 15. Through the natural area, carcasses totaled 5, and averaged .7 per mile, the minimum being 0, the maximum reaching only 2.

Along the last 9 miles of this stretch of highway, a count was kept on kangaroo-rat carcasses (*Dipodomys ordii richardsoni*). The first 2 miles of this stretch was through cultivated land, evidently inhabited by only a few rats, for the number of carcasses totaled 2, and averaged 1 per mile. Over the last 7 miles through sandhills and flats, rats were abundant. Carcasses totaled 34, and averaged 4.8 per mile, the minimum being 2, the maximum 10.—James M. Sprague, *Museum of Birds and Mammals, Lawrence, Kansas.*

ELTON'S METHOD OF PREPARING MAMMAL SKINS

Having noted Professor Elton's article in a recent issue of the Journal of Mammalogy on a new method for preparing mammal skins, we decided to try it out this summer in the field. Elton's method is to skin the mammal by casing it as fur trappers do and then inserting a flat cardboard body so that the specimen can be kept in a cellophane envelope. The space-saving advantages alone of such skins are obvious. Using this method in the field with a few modifications, we have found that it is time-saving, convenient and satisfactory for such small mammals as *Peromyscus*, *Microtus*, *Mustela* and *Sorex*. We have had no opportunity so far to use this method on larger skins. In making the slit from leg to leg, one must be careful not to tear or snip off the leg of such tiny animals as shrews. It was found that by making the slit along a line midway between the anus and the urethral opening, more skin support is given the base of the tail and a smoother ventral line is obtained. Corrugated paste-board from ordinary packing cartons proved most satisfactory for the bodies, being stiff enough for ample support and porous enough for quick drying. The strip of cardboard for a skin was always cut approximately the same length as the measured total length of that skin. The width was determined by that of the actual skin. One quickly becomes adept in approximating the correct width and trimming the cardboard to shape. Two leg wires only are necessary, one for each side of the body. These can be bent slightly at the feet so that they turn in, holding the feet to the ventral side of the skin. This insures their protection and prevents them from being broken off. We used but a single tail and body wire cut a few millimeters longer than the total length. It was inserted through the base of the nose and passed along the midline of the body to the tip of the tail. The wire projecting from the nose was then clamped down ventrally holding the cardboard and skin firmly together. The label can be sewn to the cardboard so that the free end just tucks under the skin. Elton suggests that cardboard with the label form already printed on it be used for the body. We find that the data can also be printed by hand very easily on the cardboard body after the specimen is made up.—Arthur and Ruth Dowell Svihla, *Zoology Department, University of Washington, Seattle, Washington.*

OWNERSHIP OF SEPARATES

Mr. Morrison-Scott's remarks on the distribution and ownership of separates of scientific papers in the August, 1938, number of this Journal will be accepted as pertinent in many cases. At the same time, no general dictum applies in all circumstances and it is proper to point out that those who retain separates in their personal libraries are not invariably monsters of selfishness or worse.

From the less important financial side, it is not true that an institution making possible the writing of a paper thereby has any ethical or legal claim on the separates explicitly given to the author. They are his property and he can do with them what he pleases. Moreover most authors, in this country at least, expend considerable sums

yearly in purchasing and distributing separates in addition to those received without charge. This is not begrudged as a means of apprising individuals of the work done and as a means of building up the worker's own library. But certainly few will see any reason why a man doing research on a meager salary should contribute part of it in this way to the libraries of innumerable institutions. Still on the financial theme, the possibility of building up a personal library at relatively small expense is one of the few perquisites that help make scientific salaries livable, and not a very generous one since the sums involved are not great and the personal library is used in the service of the institution in any case.

Publications really are available if the institution library has them in serial form. Of course separates are more convenient, but they obviously are not indispensable, and a separate in the office is worth ten in the library, as every worker knows. It is much more convenient to have personal separates, and since convenience is the principle advantage of separates, the case for personal ownership is usually stronger than for institution ownership. Separates in a man's office are almost always as available to others, in case of need, if owned by him as if owned by his institution. If, as some museum men do, he works at home and so requires literature there, it is certainly better for him to have his own separates than to take an institution's property to his home.

No actual data seem to be available, but it is unlikely that many personally owned separates are destroyed. They almost always pass on to the hands of other workers in the subject, which is entirely proper and useful, or into institution libraries.

There is another aspect of the matter that workers permanently located in large institutions, like those in which Mr. Morrison-Scott and I work, are likely to overlook, that is, the needs of our more isolated colleagues. To supply most of the specialists in one's own field with separates is usually not impossible, but to give separates to every local museum, college, and other place where such research is or may be done is practically out of the question. As personnel or interests change, it also commonly occurs that specialized libraries in such places are neglected and forgotten, which never happens to literature in the hands of the specialists themselves. Workers without affiliations, affiliated with small institutions, or moving about frequently, produce much important work in all fields of science, especially in zoology, and they are heavily dependent on their own libraries. They cannot acquire full files of serials and they need separates. Separates in the workers' hands are there when and where the work is to be done, while institution files are anchored and may not be where most needed.

There is also in a few large and otherwise excellent libraries a definite feeling that separates are merely duplicates of parts of serials and no effort is made to keep separates in order, to promote their collection, or to make them available. Separates sent to selected individuals are valued, but those sent to institutions often are not.

It certainly is very desirable for institution libraries to have separates, and most students will strongly endorse Mr. Morrison-Scott's remarks to this extent. It is, however, my opinion and that of many others with whom I have discussed the matter that an individual worker is well advised to distribute the bulk of his own separates to other individuals and that he is generally warranted in considering as his own property any separates received in return. He may, of course, also send separates to such few institutions as are known to use them actively in his subject, and these institutions should in turn send their pertinent publications to him, as in personal exchanges. It would, however, be far better for the institutions themselves to exchange separates, as they do serials, and to keep institutional exchanges and personal exchanges on their own proper basis.—GEORGE GAYLORD SIMPSON, *The American Museum of Natural History, New York.*

REVIEWS

Allen, Glover M. THE MAMMALS OF CHINA AND MONGOLIA, Part 1. Natural History of Central Asia, vol. xi, part I, 1938, i–xxv, 1–620 pp., 9 plates, 23 figs. American Museum of Natural History, New York. Cloth, $10.00.

Since the publication of Miller's "Mammals of Western Europe", in 1912, there has been no authoritative and comprehensive work in English on the classification of the mammals of any large continental area. Even the very broad and detailed knowledge now available on the mammals of North America has nowhere been assembled and coordinated under one cover. A large work on the mammals of central Asia, therefore, is distinctly momentous.

The present report is easily among the most important of the results of the Asiatic expeditions conducted by the American Museum of Natural History under the leadership of Dr. Roy Chapman Andrews. It is to the great credit of Dr. Andrews that he not only provided the driving force to carry out extensive field work but also considered it a personal responsibility to have the material thoroughly studied and the results published in extenso. Hence the large, thick volume which now appears as Part 1 of the report on the mammals is exhaustive and detailed, covering, besides mammals actually collected by the expeditions, all those known within the now crumbling political borders of China and Mongolia, which means about one-third of the continent of Asia. The author, Dr. Glover M. Allen, was preeminently qualified to meet the formidable and exacting requirements. Better results than those he now presents could scarcely have been hoped for.

Owing to the large number of species involved and the thoroughness with which they are treated, it was found necessary to divide the publication into two parts. Part 1, which is now issued, covers Insectivora, Chiroptera, Primates, Carnivora, Pinnipedia, Cetacea, Nomarthra, and the duplicidentate Rodentia, numbering 258 recognizable forms. Simplicidentate rodents and ungulates remain for Part 2 which is now in manuscript with publication promised for the near future.

The plan of the work is such as to make it a reservoir of historical and technical information to be drawn on by special students; at the same time, by the use of keys, distribution maps, and full descriptions, it is a manual for all. Introductory matter is confined to three chapters covering 25 pages. The first chapter is historical, reviewing the work of various collectors from Marco Polo down to Granger, Pope, and Heller of the Asiatic Expeditions; classic names forever to be associated with the natural history of China are those of Swinhoe, Père David, Anderson, Heude, and Przewalski. Discussion of faunal areas and faunal relations with North America, which are dealt with in chapters 2 and 3, is direct and factual rather than theoretical, with many stimulating remarks, but with commendable restraint in generalization and a practical absence of premature speculation. The region is divided into seven principal faunal areas descriptively defined. No faunal map is attempted, doubtless because of the imperfection of knowledge at this time.

The body of the work includes not only full treatment of species and subspecies, but also elaborate accounts of families and genera written in such simple, straightforward style that the reader will scarcely realize that the essential technical details are all there as well as the general and historical matter. A complete bibliography follows; but there is no index, this obviously being left for Part 2. Illustration is practically restricted to twenty-two distribution maps and nine half tone plates. Six of these latter show physical conditions and vegetation, mainly in Mongolia. Four others are from field photographs of living animals, all evidently from the files of the Asiatic expeditions. These, of course, fail to cover the wide field embraced by Allen.

Criticism of such an admirable work is scarcely necessary, but naturally there are some things to regret. Internal evidence here and there indicates that full consideration was not always possible for matters which arose during the unavoidably long period between the time the studies were undertaken and the time of publication. A few recent collections not to be seen in New York or Cambridge were not examined and a few titles, mostly of recent date, do not appear in the bibliography. Various involved matters of relationship or nomenclature are left with full and impartial statement of the facts, all that is possible at the present time. Citations are without mention of localities, although type localities for recognized forms appear elsewhere. Type localities for synonyms are not given except as hidden in the body of the text. A more convenient method, although not the one usually practiced, is that which makes the type locality practically a part of the citation. There is only one text figure illustrating morphological characters, considerably less than might be expected in such a pretentious work.

The report is one of the largest, most thorough, comprehensive, and altogether useful productions of its kind that has appeared for many years. Most of the credit for it should be given the author, but much is due the museum that published it and also to Dr. Walter Granger, the general editor of the series to which it belongs.—WILFRED H. OSGOOD.

W. C. McDermott. THE APE IN ANTIQUITY. Johns Hopkins University Studies in Archaeology, No. 27. Johns Hopkins Press, Baltimore, 1938, pp. xi + 338 and 10 plates; $5.00.

Slightly more than half of this book is a catalogue of 605 representations of monkeys and apes in ancient art, particularly on vases, mosaics and reliefs and in the form of figurines. Many of these old attempts at picturing apes are exceedingly crude and in only a very few instances does it seem justifiable to hazard an opinion regarding as much as the family of the animal depicted.

The chapters on "The Ape in Egypt and the Orient", "The Spread of the Ape in the Mediterranean" and "Geographical and Historical Knowledge of the Ape", deal with the growth and spread of knowledge concerning apes and monkeys in ancient civilized countries. These, and the chapters on "The Ape as a Pet and Source of Humor" and "The Ape as an Evil Beast", give a convincing picture of the great and popular interest in primates that must have prevailed in early times in the countries surrounding the Mediterranean. It is surprising to find that this wide interest had produced very little accurate knowledge but a great many superstitions concerning these animals. That the similarity of the latter to man had been fully appreciated is evident from the human attitudes and actions with which most the representations had been endowed.

Most welcome to the mammalogist is the chapter "Biological and Miscellaneous Knowledge of the Ape", which reviews conveniently parts of the writings on monkeys by Aristotle, Pliny, Galen and others and deals with the names given by some early writers to various types of primates.

This scholarly treatise would have benefited by a greater technical knowledge of primates on the part of its author, or else by restriction to the archaeological and historical approaches and omission of all biological comment on apes.—A. H. SCHULTZ.

RECENT LITERATURE

[*Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters*]

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OBITUARY NOTICES

WILLIAM BEBB

Dr. William Bebb was born at Rockford, Illinois, in 1869 and died at the McCormac State Park, Indiana, on April 7, 1938.

Like his father, he was professionally a dental surgeon of renown and he filled several important positions in the dental educational fields, mainly in the Northwestern University in Illinois and the University of Southern California. Also like his father he was an ardent naturalist but with special interest in mammals while his father was a botanist and a world authority on the willows. While his father is immortalized by *Salix bebbiana* Sargent, the son is equally honored by *Felis atrox bebbi* J. C. Merriam, a fossil saber-toothed tiger from the Rancho La Brea tar pits of southern California.

Dr. Bebb joined the American Society of Mammalogists in 1930 and would have joined earlier if his characteristic modesty had not restrained him. We had to assure him that he was perfectly qualified for membership. In 1907 Dr. C. Hart Merriam and I visited Dr. Bebb in Pasadena and were astonished to find in his collection several good skins of *Phenacomys longicaudus* and to learn how he had secured them the year before in country we had collected over without finding them. To us the species was then known only from the imperfect type specimen picked up dead on the ground in western Oregon. Dr. Bebb had found their bulky twig nests, often 100 feet up in the tops of tall Douglas firs that were being cut for lumber at the west base of Mt. Hood. As the trees crashed to the ground he examined many of these nests and found several

of the mice that had been killed or stunned by the fall. Since then the treetop habitat of these unique mice has been well studied and full accounts published but with little credit to Dr. Bebb (see North American Fauna, no. 55, p. 195).

Two of Dr. Bebb's papers have appeared in the Journal of Mammalogy: Source of small birds eaten by the coyote (vol. 15, p. 320), and The coyote and the automobile (vol. 16, p. 323), but more extensive and important papers have not to my knowledge been published. A study of the bone gnawing habits of rodents, given at the 1935 Pittsburgh meeting of the society, while important and based on ten years of careful study, was never completed to his satisfaction and another paper on traffic mortality of vertebrates was still being added to at the time of his death.

He was an ardent conservationist and much interested in humane methods of trapping. As a friend he was genial, kindly, and lovable, but as a scientist, too modest to ever become well known.—VERNON BAILEY.

KARL A. JACOBSON

Karl Jacobson, a member of the American Society of Mammalogists, died on November 13, 1938. Mr. Jacobson, who was employed by the National Park Service as a ranger, was stationed in Acadia National Park, at Bar Harbor, Maine. While patrolling a part of the park boundary on Armistice Day (Nov. 11), he was accidentally shot through the abdomen by a man who mistook him for a deer. Complications set in and he passed away three days later.

Mr. Jacobson was the first graduate student of the Wildlife Research Department, University of Maine. At one time he was employed as an Assistant of the Maine Coöperative Wildlife Research Unit, U. S. Biological Survey. He was a very promising and well-liked young man, and was doing excellent work in his new appointment.—VIOLA S. SCHANTZ.

JOHN N. LOWE

Dr. John N. Lowe, a member of the American Society of Mammalogists, died suddenly on July 27, 1938, while conducting a class tour. He collapsed from the effects of a cerebral embolism shortly after reaching the top of Hogsback Mountain near Marquette, Michigan.

He was born near Princeton, Wisconsin, October 14, 1886, and spent his boyhood no a farm. He early developed habits of study and observation which were destined to lead him to the top of the profession that grew out of his boyhood interests. As a boy he spent every moment possible out of doors, observing and classifying all the lore of nature his mind could compass.

He received the degree of Bachelor of Arts from Ripon College in 1910 and Master of Arts in 1912. He completed his graduate work at the University of Wisconsin, receiving the degree of Doctor of Philosophy in 1915. He taught at the University of Wisconsin and at Texas Agricultural and Mechanical College until he enlisted in the medical corps of the army during the World War. In 1919 he became the head of the natural science department of Northern State Teachers College, Marquette, Michigan, a position he held until his death.

He was an ardent conservationist and frequently was employed to make fish and game surveys. He was special investigator for the Michigan Conservation Commission in 1923–25 and served as special advisor to the Commission in 1925–28. He was amazingly thorough in his work. One of his projects led him to explore every stream in Menominee County, Michigan, from its mouth to its source.

His publications include Birds of Green Lake Co., Wisconsin; Reactions of Pigment Cells to Chemical Agents; Parasitic Copepods of the Brook Trout; Chromatophores of the Brook Trout; Rate of Growth of Fresh Water Fishes; Simmons Wood, a Biological Survey. He was co-author, with Michael F. Guyer, of Biological Technique, and was at work on a text book in general zoology with A. S. Pearse.—G. C. MEYLAND.

COMMENT AND NEWS

NOTICE OF ANNUAL MEETING

The twenty-first annual meeting of the American Society of Mammalogists will be held at the Louisiana State University, University, Louisiana (near Baton Rouge), from Monday, April 3, to Friday, April 7, 1939. Headquarters will be at the Heidelburg Hotel and the public meetings will be held on the University Campus. Monday will be devoted to business sessions; Tuesday, Wednesday, and Thursday to the presentation and discussion of papers, and Friday to an all day field trip.

It is hoped that since Louisiana is somewhat of a focal point between the east and the west, and since the meeting is to be held during the Easter holiday period, that a large number of members will avail themselves of the opportunity of attending this meeting. This is also the first meeting of the Society in the deep South. The Friday field trip is being so planned as to give visitors an insight into the many attractive features of this section, both historical and biological. It is urged that members bring their wives, as much of interest is being arranged for them.

The local Committee on Arrangements comprises: Miss Fannye A. Cook, Wm. H. Gates, E. A. McIlhenny, W. P. Taylor, Ira D. George, and George H. Lowery, Jr., Chairman. Further details of the meeting may be received from the Local Committee; titles of papers should be sent to the Secretary, W. B. Davis, Texas A. and M. College, College Station, Texas, before March 15. It is especially requested that persons who contribute papers will submit with their titles an abstract of not more than 200 words and a statement as to the kind of illustrations, if any, and the length of time necessary for presentation of each paper.

EXTRACT FROM A PAPER READ BY PRESIDENT JOSEPH GRINNELL AT THE 20TH ANNUAL MEETING OF THE SOCIETY ON JULY 21, 1938

In order to obtain the ideas of many people well qualified to have opinions concerning the proper functions of our Society, I last December wrote letters to upwards of one hundred persons, nearly all charter members of this organization. I stressed my earnest desire for expressions that should not only be favorable, if such were honestly forthcoming, but also unfavorably critical, in any respect whatsoever. I got 46 replies. The tenor of 26 of these was favorable on all the scores mentioned by the writers, and of the remaining 20 none was wholly unfavorable and the criticism offered was presented in a constructive manner.

One thing surprised me, although upon reflection I find it reasonable: In many members' minds the purposes and functions of the Society and of our Journal of Mammalogy are the same, or are so intermingled that it is impracticable to catalog them apart. Since the general significance I now find is about the same for my analysis of these opinions, I will make only partial segregation.

As regards more especially the Society, spread and direction of interest in the natural history of wild-living mammals was mentioned as a valid function more often than anything else; this was approved of *as is* but also was urged for future greater emphasis. Two members thought that more effort should be made to reach young people. One thought we should participate in educational activities in a larger way.

Four members felt that the Society, especially in its publications, might better concern itself with purely scientific or technical mammalogy, leaving the applied or economic phases for promotion under some other organization. On the other hand, eight members definitely, and many others by implication, felt that we should be yet more active in guiding applied mammalogy and especially in dealing with conservation matters.

On the technical side, four members urged, with appealing reasons, that the Society take steps to issue a standard check-list of North American mammals, on a par with the American Ornithologists' Union Check-list of North American Birds. This service, it was pointed out, might well be assumed by our existing Standing Committee on Nomenclature. There are numerous moot nomenclatural cases that only study and decision of such a representative committee could settle satisfactorily. Two members even suggested that this same committee should prepare and publish a code of nomenclature, especially applicable in systematic mammalogy. This, of course, would mainly supplement the International Zoological Code, not supersede it nor conflict with it in any way.

Regarding our Journal of Mammalogy the main tenor of the 46 replies was in high praise. Just one single adverse criticism of editorial technique was expressed—that being a plaint on the score of lack of uniformity of forms of citation of articles in text and bibliographies. Favorable comments especially stressed the great value to all mammalogists of the lists of recent literature, these providing a practically complete index to the literature of the world. Reviews were commended; "wish there were more", one member said. The short, general notes were specifically approved of by several.

As regards nature of articles appearing in the Journal, most frequently expressed approbation applied to those describing the habits and interrelationships of mammals. More of such were called for, as also of articles dealing with problems and practices in conservation; no less than eight members dealt at length with this latter subject.

Definite dissatisfaction (although, again, always tempered with additional, commendatory comment) was voiced as follows: By three, that there is too much, relatively, printed of quantitative and "laboratory" matter. Two members said that there are too many articles "written by college students" [*sic*]. Three wanted to reduce or eliminate articles purely anatomical or morphological in nature, pointing out the fact that there are other established vehicles for that type of article. On the other hand, ten or more members commented favorably upon the wide variety of subjects dealt with in articles as presented in the current issues of the Journal. One's views are beneficially broadened by their reading. Five members thought a more desirable balance would be reached by accepting more articles (if and as available) of ecologic and economic type; this, of course, is a near-duplication of ideas I have already cited.

To sum up as regards textual content of the Journal, there seemed to be a majority call for an increase in good (not at all necessarily "popular") natural history of mammals, the results of original field observation.

Toward improvement of the Journal's pictorial features, one member would like to see more plates; another wants to see a frontispiece in each issue, from a high-class photograph of a living subject, or from a painting. These features would, grantedly, win admiration from a large proportion of our readers. But cost is involved; and, as our Board of Directors well knows, under present conditions of finance our Editorial Committee is doing the very best it can with the funds at its disposal.

Finally, I will try fairly to formulate a set of conclusions from the expressions forthcoming from the sources I have cited, which sources, please note, were *within our Society*.

1. To encourage mammalogical research, in special ways, as by affording means of publishing results, by mutual association and discussion, by bestowal of honors (at least through elections to high office), and by expression of approval of worthy projects in field, laboratory and museum.

2. To insist upon high scientific standards, irrespective of nonprofessional demand, in our Journal and other Society-sponsored publications, and in the programs of our annual meetings.

If these two formulations be accepted as essentially valid aims of our organization, then they may be enlarged upon further with probable propriety to bring in the principle of service:

(a) To make available to people at large a correct knowledge of wild mammals—to give them a really intelligent understanding of the problems of mammalian existence, this understanding as reaching also into the interrelationships of wild mammals with human economics.

(b) To exercise definite, vigorous influence toward shaping and guiding policies of action on the part of individuals and of other organizations, especially those that have to do with wild-life preservation, administration of wild-life resources, and popular education in general natural history.

These statements of aims and functions in no way conflict with the Society's By-laws as they now stand; the margin of amplification suggested I believe to be consistent with those By-laws, and most certainly they accord with the majority judgment of the charter members whose ideas I elicited and have cited.—JOSEPH GRINNELL.

NATIONAL PARK SERVICE

The National Park Service wishes to announce completion of a year's intensive field research on coyote-prey interrelationships in Yellowstone National Park and vicinity, by Dr. Adolph Murie, Wildlife Technician of the Service, who has recently submitted a report on his field investigation for administrative use.

The survey was authorized by the Regional Office, at the request of the Director, to determine whether there is any need, at present, for coyote control in the park, and whether there is evidence to prove that certain game species are in any danger of extermination by coyotes, as has been charged.

Study was made of coyote food habits—what the species eats and to what extent—by analysis of droppings. To date, 7841 individual food items, found in 4,488 scats, have been classified. The status of "game" species was found to be satisfactory; there was no indication that the populations of antelope, bighorn, mule deer, Canada geese or trumpeter swans were threatened by coyote depredation. No general exodus of coyotes to surrounding regions was found to occur.

A detailed report of the study will be prepared this winter for publication.

Within the recently established Arizona No. 3 Grazing District in Yuma, Maricopa, and Pima Counties are areas that are dry, rugged, and generally inhospitable to domestic animals but are vitally important to native species of wild life. Especially are they strongholds of the rapidly disappearing desert bighorn or mountain sheep.

Responding to suggestions that native plants and animals be protected, the Division of Grazing has requested the National Park Service to join in a survey that would look to setting aside certain areas within the grazing district in which the primary consideration will be the allotment of lands for the benefit of native animals and birds.

To undertake necessary research and to advise on steps leading to establishment of wild life allotments in conformance with the needs of the local livestock industry, the National Park Service has engaged the services of Mr. A. A. Nichol, formerly of the staff of the University of Arizona. Mr. Nichol has been engaged during the past two years in a study of the bighorn of Arizona under the National Association of Audubon Societies. He brings to this work a lifetime of practical experience in the deserts and mountains of the Southwest as well as a background of academic knowledge and a thorough acquaintance with the bighorn and other wild life native to this general territory.

DEPARTMENT OF COMMERCE

A new (eighth) edition of Department of Commerce Circular No. 286 was issued under date of July 1, 1937, containing the laws and regulations for the protection of walruses and sea lions in Alaska. The prohibition on the killing of walruses was extended to cover the period from July 1, 1937, to June 30, 1939, and no change was made in the regulations previously in effect concerning the killing of sea lions. Walruses may be taken only by natives for food or clothing, by miners or explorers when in need of food, or by collectors of specimens for scientific purposes under permits issued by the Secretary of Commerce. Similar conditions apply in respect to the taking of sea lions, and their killing is permissible also in the necessary protection of property or while the animals are destroying salmon or other food fish.

This was the first year of operation under the international treaty for the regulation of whaling, the act of May 1, 1936, giving effect thereto, and the joint regulations of the Secretary of the Treasury and the Secretary of Commerce issued on October 9, 1936.

There were 376 whales taken in 1937, consisting of 1 sei whale, and 170 finback, 104 humpback, 45 sulphur bottom, and 56 sperm whales.

Revised figures for 1936 show a total catch of 372 whales, instead of 385, the original report of the Port Hobron station having included by mistake 13 embryo whales, of which 2 were finback and 11 humpback. The total catch in 1937, therefore, represents an increase of 4 whales over the number taken in the previous year.

BIOLOGICAL ABSTRACTS

A plan has been evolved whereby *Biological Abstracts*, while continuing to appear as a single complete entity, might, without repaging or other change except in the cover, be also broken up into several subject groups which would be made available to individuals not desiring the complete service. The following subject grouping into five "reprint" parts is adopted for 1939.

I. *Abstracts of General Biology* to include General Biology, Biography-History, Bibliography, Evolution, Cytology, Genetics, Biometry, and Ecology; price $4.

II. *Abstracts of Experimental Animal Biology* to include Animal Physiology, Nutrition, Pharmacology, Pathology, Anatomy, Embryology, and Animal Production; $9.

III. *Abstracts of Microbiology and Parasitology* to include Immunology, Bacteriology, Viruses, Parasitology, Protozoology, and Helminthology; $5.

IV. *Abstracts of Plant Sciences* to include Phytopathology, Plant Physiology, Plant Anatomy, Paleobotany, Systematic Botany, Agronomy, Horticulture, Forestry, Pharmacognosy, and Pharmaceutical Botany; $6.

V. *Abstracts of Animal Sciences* to include Paleozoology, Parasitology, Protozoology, and Helminthology, Systematic Zoology, and Economic Entomology; $6.

The subscription price for the complete volume 13 for 1939 will be $25 to individual subscribers and institutions alike.